ENGINEERING

An Illustrated Weekly Journal

35 & 36 BEDFORD STREET, STRAND, LONDON, W.C.2 - - TELEPHONE: TEMPLE BAR 3663

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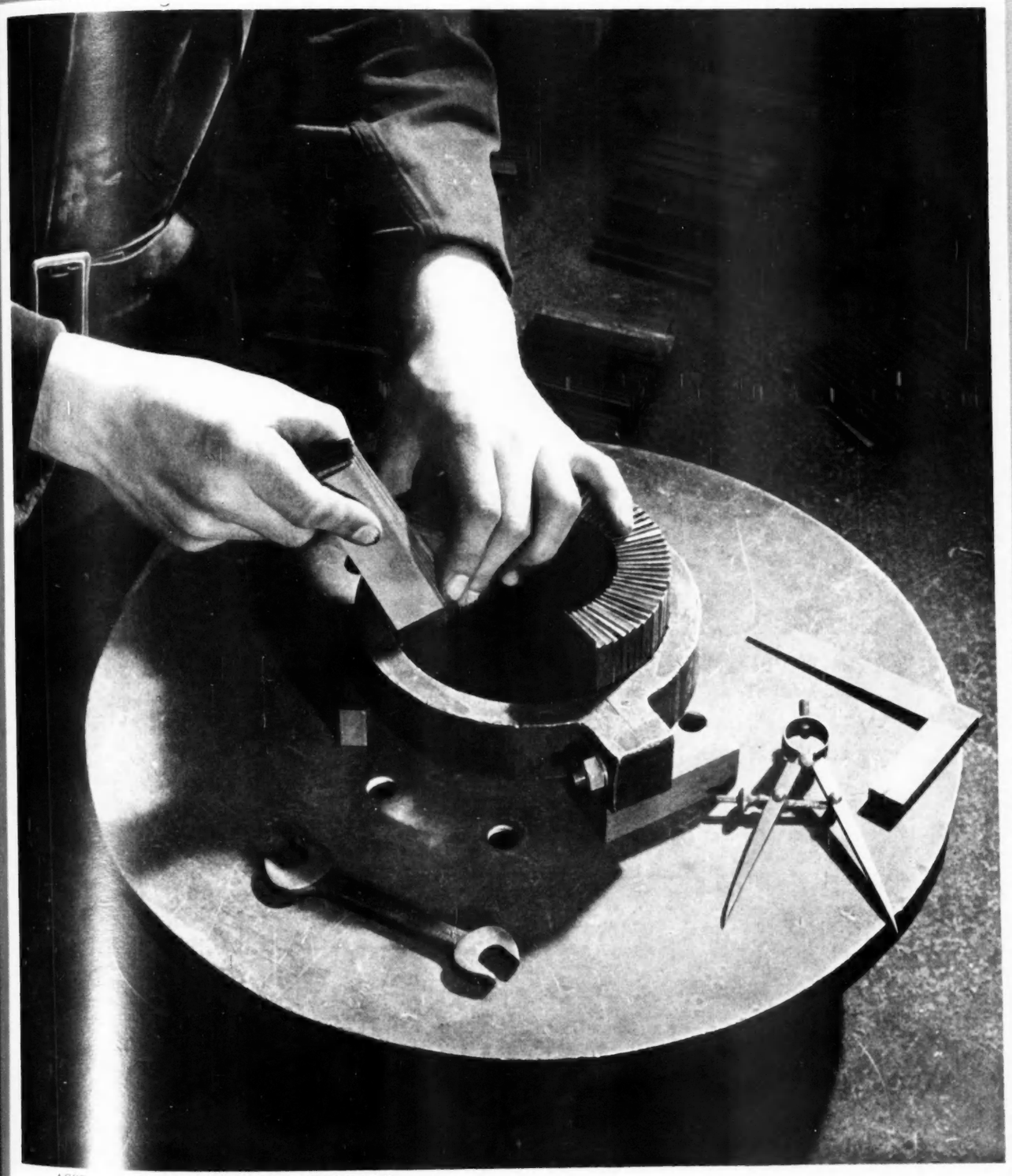
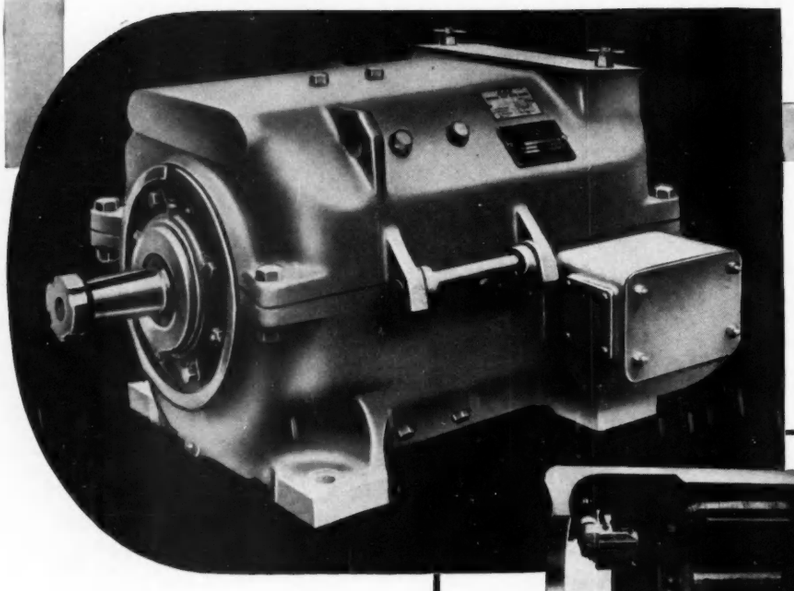
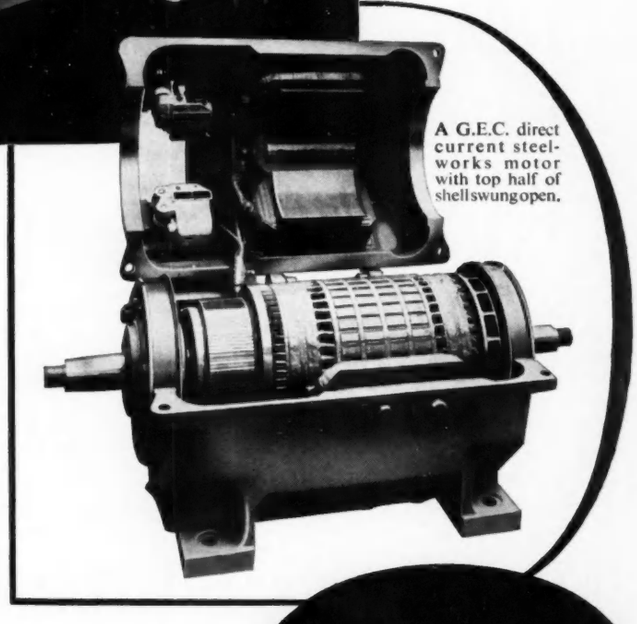


ASSE[illegible]NG COMMUTATOR SEGMENTS

STEELWORKS D.C. MOTORS



A typical G.E.C. direct current steelworks motor.



A G.E.C. direct current steelworks motor with top half of shell swung open.

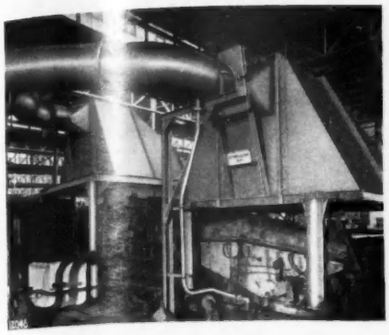
G.E.C. steelworks motors are available from 5 h.p. to 200 h.p. and comply fully with the dimensions and ratings standardised by the American Association of Iron & Steel Electrical Engineers.

The motors are of extremely robust construction and are specially designed for quick starting, stopping and reversing.

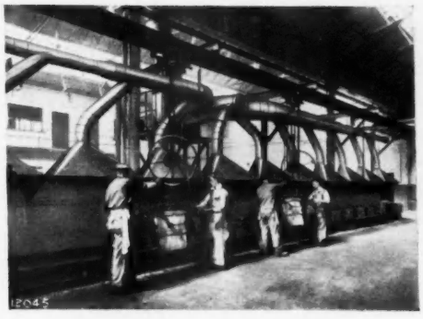
Ask for Technical Descriptions Nos. 362 and 419.

G.E.C.

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2



Fume Exhaust from Batch Pickle Plant



Fume Exhaust from Foundry Pouring Station

Fume Exhaust from Spray Booth

INDUSTRIAL PROCESS VENTILATION

BY Sturtevant

The Sturtevant Company install ventilation plant which overcomes unfavourable atmospheric conditions or intense heat caused by a variety of industrial processes, Each case is examined as a separate problem and then the most efficient and economical plant is fitted.

FUMES REMOVED AT SOURCE

Sturtevant Localised Exhaust installations are working in conjunction with many processes:—

- **Obnoxious and Dangerous fumes** from furnaces, stoves, ovens and spray booths.
- **Corrosive fumes** from dipping and cleaning baths and pickling plants.
- **Dust and fumes** from pouring stations, knockouts, etc., in iron and steel foundries.

FRESH AIR SUPPLY

Sturtevant Positive Ventilation systems produce the best working conditions and minimise physiological discomfort.

- **Areas of intense heat**—in steel works, tin plate works, gas works, glass works, etc.
- **Product Cooling Plants** are made for a wide variety of manufactures and machinery in operation.

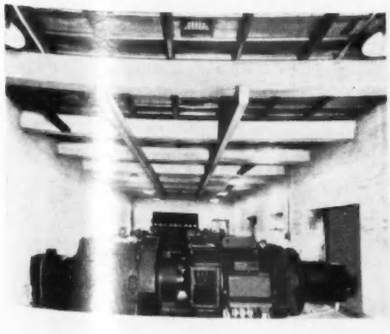
Complementary systems of Positive and Exhaust Ventilation are often installed to great advantage.

Write for our publications D. 3603 "Sturtevant Exhaust Ventilation" and D. 3702 "Positive Ventilation"

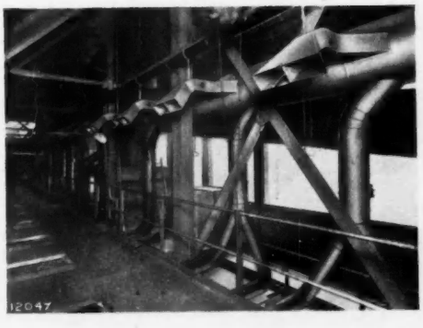
STURTEVANT ENGINEERING CO. LTD.

Southern House, Cannon Street, London, E.C.4

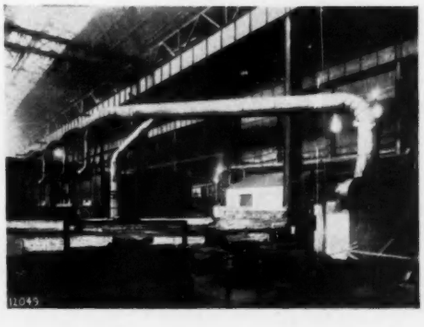
Cool Air Supply to Motor Generating Room



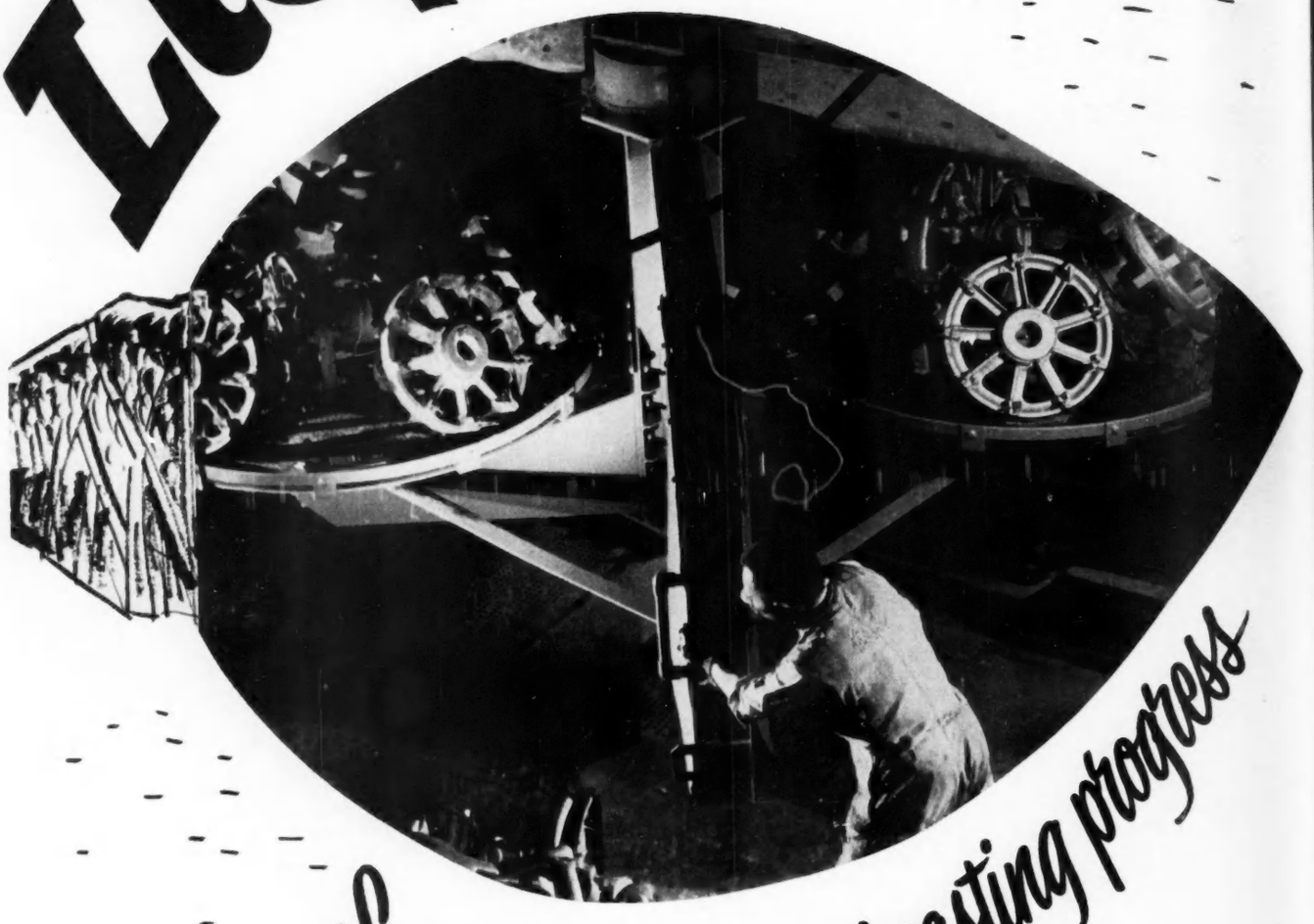
Cool Air Supply to Retort House



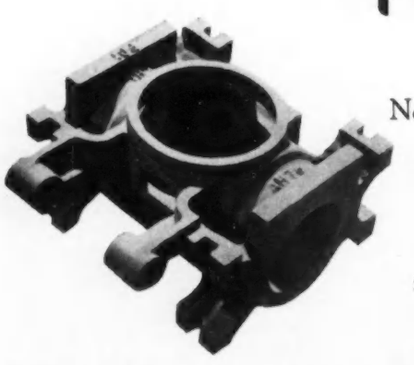
Cool Air Supply to Tin Plate Mill



Lloyds



Spearhead of steel casting progress



SWIVEL HEAD HOUSING *Drilling apparatus component, weight 42 lbs., dimensions 12" x 14" x 6½", cast for Boyle Bros. Drilling Co., Ltd.*

No foundry has done more to advance the quality of steel castings than F. H. Lloyd & Co. Ltd. None are more research minded or ready to adopt modern techniques and labour saving plant. Lloyds have invested heavily in high K.V.A. furnaces for quicker and better melting. The fettling tempo is speeded by Hydroblast which ensures thorough cleaning of large and intricate castings, powder washing that literally burns castings clean, and knock off risers. New Moulding equipment includes mould surface treatment for a smoother casting surface, and the Speedslinger, the first to be used in this country, which rams one ton of sand per minute. And behind the new equipment and techniques, are the men whose inherent skill and experience wed hand made perfection to machine made efficiency.

LLOYDS — Europe's Best Equipped Steel Foundry

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Specialists in the design and construction of Steam-Raising Plant, utilising waste gases, in the Gas, Chemical and Ceramic Industries; also the Iron and Steel Industries. Heat-recovery from internal combustion engines and similar prime movers in Land and Marine Installations. A direct method of saving fuel.

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WM. JAS. GLOVER & CO. LTD. ST. HELENS

ESTABLISHED 1816

RELIABILITY

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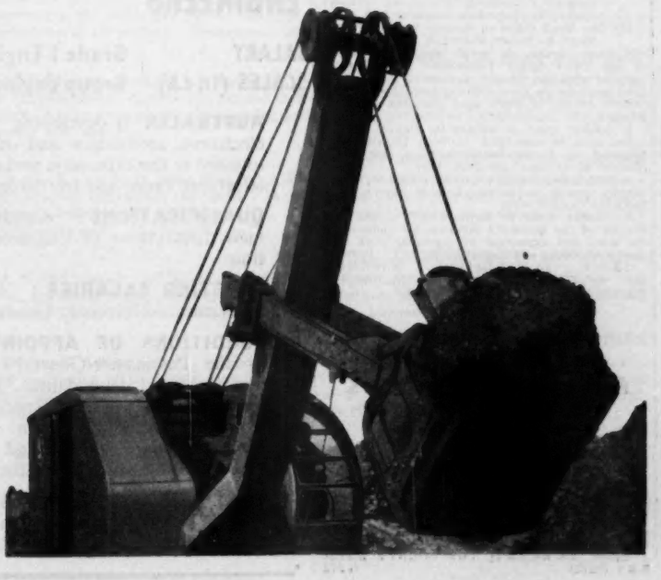
"GLOVER'S BEST" STEEL WIRE ROPES FOR ALL PURPOSES

SPECIAL TYPES OF CRANE AND EXCAVATOR ROPES TO SUIT ALL CONDITIONS



THE EXCAVATOR

ILLUSTRATED MANUFACTURED BY

THOMAS SMITH & SONS (RODLEY) LTD., RODLEY, Near LEEDS.

OUR ROPES ARE USED ON SMITH'S EXCAVATORS.

CLASSIFIED ADVERTISEMENTS SECTION.

For all advertisements classified under the headings of Tenders, Appointments Open, Situations Wanted, Patent Agents, Partnerships, Wanted, &c., Auction Sales, Publications For Sale, Miscellaneous and Public Notices, &c., the charge will be **12s.** for the first four lines or under and **3s.** per line up to one inch. When an advertisement measures an inch or more, the charge will be at the rate of **36s.** per inch. 5% allowed on 6, 10% on 13, 15% on 26 and 20% on 52 Weekly insertions. If use is made of a box number the extra charge is **2s.** per insertion with the exception of advertisements appearing under Situations Wanted. Prospectuses and Notices of Company Meetings **£25** per column. Copy instructions must be in our hands first post Monday for the following Friday's issue. Address to the Manager, ENGINEERING LTD., 35 and 36, Bedford St., Strand, W.C.2. Inclusion of advertisements must be dependent on space being available.

PUBLIC NOTICE.

THE COLLEGE OF AERONAUTICS.

ENGLISH ELECTRIC RESEARCH FELLOWSHIP IN AERONAUTICS.

Applications are invited for a

RESEARCH FELLOWSHIP which has been established at the College by the English Electric Co., Ltd. The Fellowship is intended to provide opportunity for post-graduate research into problems of vibration or stability and control of aircraft, and is tenable for one year beginning on or about 1st October, 1956. The value of the Fellowship is £500.

Applications, giving full particulars of education and experience and quoting the names of three referees, are required by 1st May, 1956, and should be addressed to: THE WARDEN, THE COLLEGE OF AERONAUTICS, CRANFIELD, BLETCHLEY, BUCKS. K 909

EDUCATIONAL.

FREE. Brochure giving details of courses in **Mechanical and Production Engineering, Draughtsmanship, etc.,** for the **A.M.I.Mech.E., A.M.I.P.E., City and Guilds and other Professional examinations. B.M.I. INSTITUTES, DEPT. EG. 30, LONDON, W.4. (ASSOCIATED WITH H.M.V.).** G 619

IMPERIAL COLLEGE.

BURSARIES IN HIGHWAY ENGINEERING provided by the Rees Jeffreys Road Fund tenable from October, 1956. Value ranges from £325-£500 p.a. plus fees.—Further particulars from the REGISTRAR, IMPERIAL COLLEGE, LONDON, S.W.7, who should receive applications naming two referees by May 30th, 1956. K 845

EXPERIMENTAL WORK.

RESEARCH ENGINEERS LIMITED,

Northampton Grove, Canonbury, London, N.1. Canonbury 4244/5/6. We have over 25 years' experience of experimental work and prototypes. We design, develop and manufacture special purpose and labour saving machines, all at the above address. Our range is from the smallest scientific instruments to 3- or 4-ton machines. After a prototype machine has been made and found satisfactory we can manufacture as many as are required.

G 656

COURSES.

GLAMORGAN EDUCATION COMMITTEE.

GLAMORGAN SUMMER SCHOOL OF SCIENCE AND TECHNOLOGY,
UNIVERSITY COLLEGE, SWANSEA.
23rd JULY to 11th AUGUST, 1956.

The above Summer School is organised for **APPRENTICES AND OTHERS EMPLOYED IN THE ENGINEERING AND MINING INDUSTRIES** who are at present following part-time courses in Technical Colleges leading to the Ordinary and Higher National Certificates in Mechanical, Electrical or Mining Engineering or Mining Surveying. The School is held for three weeks full-time at the University College, Swansea, and the courses provide theoretical and practical instruction in the subjects appropriate to the various stages of the National Certificate Courses:—

Engineering I, for students now pursuing a Preliminary Course.
Engineering II, for students now pursuing an S.1 Course.
Mechanical or Electrical Engineering III, for students now pursuing an S.2 Course.
Mechanical or Electrical Engineering IV, for students now pursuing an S.3 Course.
Mechanical or Electrical Engineering V, for students now pursuing an A.1 Course.
Mining and Mining Surveying II, for students now pursuing an S.1 Course.
Mining and Mining Surveying III, for students now pursuing an S.2 Course.
Mining and Mining Surveying IV, for students now pursuing an S.3 Course.
Mining V, for students now pursuing an A.1 Course.

Further particulars, and application forms which must be returned by 30th April, 1956, may be obtained from the undersigned.

EMLYN STEPHENS,
Director of Education.
County Hall, Cardiff. K 874

TENDERS.

MINISTRY OF TRANSPORT AND CIVIL AVIATION.

DERBY-UTTOXETER TRUNK ROAD A516

RECONSTRUCTION OF OVERLINE BRIDGE AT ETWALL STATION, DERBYSHIRE.

The Minister of Transport and Civil Aviation invites **TENDERS** for the **RECONSTRUCTION OF THE DECK OF THE ABOVE BRIDGE** consisting of a single span of steel joists in concrete 30 ft. long by 35 ft. wide between parapets.

Contract documents and drawings may be obtained from the Consulting Engineer, A. M. Hamilton, M.I.C.E., M.Cons.E., 17, Dartmouth Street, S.W.1, on payment of a deposit of £5 by cheque or draft made payable to the Ministry of Transport and Civil Aviation. The deposit will be returned if a bona fide tender is submitted and not subsequently withdrawn. Prospective tenderers may inspect contract documents and drawings at the offices of the Consulting Engineer before payment of the deposit.

Tenders on the official form, which must be received before 4 p.m. on Tuesday, 17th April, 1956, should be sent in a sealed REGISTERED envelope marked "Tender for Etwall Station Bridge" addressed to the ASSISTANT SECRETARY, HIGHWAYS DEVELOPMENT DIVISION, MINISTRY OF TRANSPORT AND CIVIL AVIATION, 21/37, HEREFORD ROAD, LONDON, W.2.

The Minister does not bind himself to accept the lowest or any tender.

H. GILLENDER,
An Assistant Secretary. K 904

IRAQ GOVERNMENT.
DEVELOPMENT BOARD.

DOKAN DAM—CONTRACT NO. 1

SUB-CONTRACT FOR ELECTRICAL AND MECHANICAL EQUIPMENT.

1. Acting on behalf of the Development Board of the Government of Iraq, **TENDERS** are invited by Group Dumez-Ballot of Baghdad for a Sub-Contract for the Supply and Installation at Dokan Dam, on the Lesser Zab River, Iraq, of electrical and mechanical equipment including the following:

(a) **DIESEL-ELECTRIC GENERATING PLANT** of approximately 1350 kilowatts capacity.
(b) **6.6 KILOVOLT RING MAIN DISTRIBUTION SYSTEM** approximately 3700 metres in length, complete with sub-station equipment.
(c) **ELECTRICALLY OPERATED LIFT INSTALLATION.**
(d) **STREET AND DAM CREST LIGHTING INSTALLATION.**
(e) **MISCELLANEOUS CABLE AND MINOR ELECTRICAL AND MECHANICAL INSTALLATIONS.**

2. The successful tenderer will be required to enter into a contract with the Main Contractors at an early date, rapid delivery of the equipment being essential.

3. Sub-Contract Documents including the Contract Documents for the Main Civil Engineering Contract and drawings may be inspected at any of the following places, namely:—

(a) The Offices of the Development Board, Baghdad.
(b) The Iraqi Embassy, London.
(c) The Iraqi Embassy, Washington.
(d) The Royal Iraqi Legation, Paris.
(e) The Royal Iraqi Legation, Brussels.
(f) The Royal Iraqi Legation, Rome.
(g) The Head Office of Messrs. Binnie, Deacon & Gourley (Consulting Engineers), Artillery House, Artillery Row, London, S.W.1.
(h) The Head Office of Societe Dumez, 33, rue Henri Rochefort, Paris 17e, France.

4. Firms desiring to tender may obtain copies of the Sub-Contract Documents and Drawings together with the relative sections of the Contract Documents for the main civil engineering works from Societe Dumez of Paris upon payment of 20,000 francs.

5. Tenders must be written in English and six copies must be submitted to Group Dumez-Ballot, Baghdad, c/o Societe Dumez in Paris, and will be received up to noon 15th June, 1956.

A further two copies are to be posted to Messrs. Binnie, Deacon & Gourley's London office, to reach them the day following.

6. Tenders must be accompanied by full particulars of the tenderer's facilities for undertaking the work and experience of executing work of a similar character and magnitude.

GROUP DUMEZ-BALLOT, BAGHDAD,
c/o SOCIETE DUMEZ, 33, RUE HENRI ROCHEFORT, PARIS, 17e, FRANCE. K 869

PUBLIC APPOINTMENTS.

LONDON COUNTY COUNCIL.

ARCHITECT'S DEPARTMENT.

Vacancies for
ENGINEERING ASSISTANTS (up to £783) and Engineer Grade III (up to £945) in the Structural Engineering Division. Work includes steelwork and reinforced-concrete design and detailing for Council's buildings. Particulars and application forms from Architect (AR/EK/SE/1), THE COUNTY HALL, S.E.1. (1272). G 573

THE ROYAL TECHNICAL COLLEGE, GLASGOW.
(Affiliated to the University of Glasgow.)

CHAIR OF INDUSTRIAL ADMINISTRATION.

The Governors invite applications for the Chair of Industrial Administration. The salary attached to the Chair is £1900 by £100 to £2200. Particulars of the appointment and forms of application may be obtained from the SECRETARY-TREASURER, GEORGE STREET, GLASGOW, C.1. K 896

BOROUGH POLYTECHNIC.
BOROUGH ROAD, S.E.1.

Principal: DOUGLAS H. INGALL, D.Sc., F.R.I.C., F.Inst.P., Hon. M.I.H.V.E.

HEAD OF THE DEPARTMENT OF MECHANICAL ENGINEERING.

The Governing Body invites applications from suitably qualified persons for appointment to the post of Head of the Department of Mechanical Engineering which will become vacant on the 31st August, 1956. Candidates should be graduates of a British University and have had good experience in teaching and in industry.

The Department is recognised as a Grade IV department, and the salary scale of the Head is £1365 per annum rising by annual increments of £25 to a maximum of £1515 plus London Allowance.

Further particulars and forms of application may be obtained from the undersigned.

FREDK. J. PACKER,
Clerk to the Governing Body. K 887

MINISTRY OF SUPPLY requires **ENGINEERS** at NOTTINGHAM to control all design aspects of production of A.A. guns and equipments, involving staff control and liaison duties. Qualifications: British of British parents. Recognised engineering apprenticeship and A.M.I.C.E. or Mech.E. or E.E. or exempting qualifications. Good experience essential in design and manufacture similar to that stated. Salary: Within £1075-£1375 p.a.—Application forms from M.L. & N.S., TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting C249/6A. K 905

CYPRUS.
WATER DEVELOPMENT DEPARTMENT.

EXECUTIVE ENGINEERS, CLASS I.

Appointment on contract/gratuity terms for four years in first instance.

Gross emoluments in scale £1483-£1857 plus cost-of-living allowance. Substantial gratuity on completion of contract. Free passages. Free medical attention for Officers. Generous home leave. Low income tax. Candidate should hold a University degree or diploma recognised as exempting from or have passed Final Parts I and II of the A.M.I.C.E. examination and have considerable experience in civil engineering, including design and construction of water supply and/or irrigation works.

Apply in writing to DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, LONDON, S.W.1. Give brief details of age, qualifications and experience. Quote reference BCD/140/17/02/D5. K 906

DARLINGTON EDUCATION COMMITTEE.

COLLEGE OF FURTHER EDUCATION.

Principal: C. E. BEYNON, B.Sc., F.R.I.C., A.Inst.P.

Required in September:—

(a) **SENIOR LECTURER IN MECHANICAL ENGINEERING** to specialise in Heat Engines and assist with Strength of Materials or Theory of Machines; graduate and/or equivalent professional qualification essential.

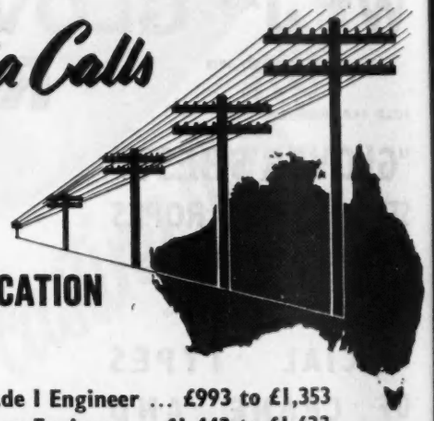
(b) **ASSISTANT (GRADE B) IN MACHINE SHOP ENGINEERING** to teach to G. & G.I. final examination. Academic qualifications to include H.N.C. in Production Engineering or equivalent.

(c) **ASSISTANT (GRADE B) IN CHEMISTRY.** Ability to offer Metallurgy or Physics an advantage. Graduate qualification essential, membership of professional association desirable.

Salaries in accordance with Burnham Report as follows: Senior Lecturer £1065 by £25 to £1215; Assistant (Grade B) £525 by £25 to £820. Additions in case of Assistants, for degree, professional and teaching experience and training.

Further particulars, and application forms (to be completed and returned not later than April 13) may be obtained from the EDUCATION OFFICE, NORTH LODGE, DARLINGTON.

D. PETER,
Chief Education Officer. K 820



TELECOMMUNICATION ENGINEERS

SALARY SCALES (In £A) { Grade I Engineer ... £993 to £1,353 / Group Engineer ... £1,443 to £1,623

AUSTRALIA is developing rapidly and urgently needs electrical, electronic, mechanical and other professionally qualified engineers to assist in the expansion and maintenance of its national telephone, telegraph, radio and television services.

QUALIFICATIONS: Graduate or Corporate Membership of main Institutions of Engineers, or equivalent academic qualifications.

STARTING SALARIES: According to qualifications and experience. University Graduates £993 to £1,128 minimum.

CONDITIONS OF APPOINTMENT: Permanent appointment to the Postmaster-General's Department. Free passages for appointee and dependants. Initial accommodation provided. In approved circumstances, special settling-in allowances. Full salary from date of embarkation. Superannuation, annual and sick leave conditions. Four and a-half months' furlough after fifteen years. Good opportunity for advancement.

FOR FURTHER DETAILS: Engineers qualified or about to qualify, inquire from Australian Post Office Representative, Australia House, Strand, London, W.C.2. K 891

AIR MINISTRY require **CIVIL ENGINEERS** for duty in their Works Department for engineering and administrative work on the construction and maintenance of civil engineering and building projects (covering barracks, workshops, runways, roads, water supply, sewage, drainage works, etc.) on R.A.F. and Civil Aviation stations. Appointments carry liability for service overseas and will be in two grades: (*a*) Main grade, salary scale £1182 to £1527; (*b*) Assistant grade, £761 to £1182. Salaries somewhat lower in provinces. Lodging allowance payable in certain circumstances for appointments in Assistant Grade. A special allowance of up to £1500 a year according to location is payable in addition to salary during overseas service. Appointments non-pensionable but with long term possibilities. Candidates must normally be natural born British subjects of natural born British parents. Qualifications (Main Grade) must be corporate members of the Institution of Civil Engineers or Institution of Municipal Engineers. A degree in civil engineering would be an advantage. (Assistant Grade) either B.Sc. (Eng.) or equivalent, A.M.I.C.E. or A.M.I.Mun.E. or Parts I and II of the Institution of Civil Engineers or the Testamur of the Institution of Municipal Engineers and have at least two years' civil engineering experience on the staff of a Government Department, Local Authority, or a firm of Consulting Engineers or Contractors of good standing. Initial appointments to locations as at or nearest to those specified by applicants arranged as far as possible.—Applications quoting reference E.40/6A (Main Grade) and E.41/6A (Assistant Grade) from M.L.N.S., TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1. K 327

COUNTY BOROUGH OF DONCASTER
EDUCATION COMMITTEE.

DONCASTER TECHNICAL COLLEGE.
Principal: W. LOMAX, M.Eng., B.Sc., M.I.Min.E.

Applications are invited for the following posts in the Electrical Engineering Department.

SENIOR LECTURER :

Applicants should possess a good Honours Degree and suitable industrial and teaching experience. Ability to teach Electrical Engineering Theory and Applied Electronics to the standard of Part III of the A.M.I.E.E. examination is essential. Salary in accordance with Burnham Technical Scale for Senior Lecturers. (£1065-£1215 p.a.)

LECTURER :

Applicants should possess a University Degree and/or Corporate Membership of the Institution of Electrical Engineers and have suitable industrial experience. Some teaching experience is desirable. Teaching duties will include H.N.C. (final) classes and ability to teach Electrical Power or Electrical Machinery to Post-H.N.C. classes would be an advantage. Salary in accordance with Burnham Technical Scale for Lecturers. (£965-£1065 p.a.)

V. H. HOSKIN,
CHIEF EDUCATION OFFICER.
EDUCATION OFFICES,
WHITAKER STREET,
DONCASTER. K 468

ADMIRALTY.
ROYAL NAVAL SCIENTIFIC SERVICE.

DRAUGHTSMEN required in Admiralty Research and Development Establishments in London (Teddington area), Portsmouth, Weymouth, and Baldock (Herts) for the design of experimental apparatus needed for fundamental research or for fitting in H.M. ships. Experience is necessary in any of the following classes of equipment: light to medium electrical, electro-mechanical, precision mechanical and electronic.

Candidates must be British aged 21 years or over, with at least 3 years' practical workshop training and, preferably, with drawing office experience and/or possession of the O.N.C. or equivalent.

Appointments unestablished, but opportunities will occur to compete for established posts and for promotion.

Starting pay (London rate), £463 10s. per annum (aged 21), £635 (aged 28) rising by 4 increments to £725 per annum; slightly less in the Provinces.

Apply stating age, training, experience and qualifications to ADMIRALTY, SANCTUARY BUILDINGS (ROOM 151), GREAT SMITH STREET, LONDON, S.W.1. G 636

AIR MINISTRY Works Designs Branch requires (A) in LONDON

(1) **DESIGNER/DRAUGHTSMEN (ORDER NO. 2308) FOR BULK PETROLEUM STORAGE AND PUMPING INSTALLATIONS** experienced in one or more of the following:—(*a*) storage tank layout and design, (*b*) pump house and plant layout, (*c*) development of pipe line schemes (*d*) hydraulic calculations. Technical training to O.N.C. standard required. Salaries up to £725 p.a.

(2) **STRUCTURAL ENGINEERING DESIGNER/DRAUGHTSMEN (ORDER NO. 2304)** for reinforced concrete or structural steel with sound technical training and several years varied experience in design/detailing of:—(*a*) Reinforced concrete construction for all types of buildings, or (*b*) steel framed sheds, warehouses and similar buildings, and

CIVIL ENGINEERING DESIGNER/DRAUGHTSMEN (ORDER NO. 2305) experienced in one or more of the following branches of engineering:—(*a*) Earthworks and Stormwater Drainage, (*b*) Foul Drainage and small disposal works, (*c*) Water Pumping Treatment and Distribution. Salaries up to £850 p.a.

(B) IN LONDON AND PROVINCES (with liability for overseas service)

ELECTRICAL ENGINEERING DRAUGHTSMEN (ORDER NO. 2307) experience in preparation of schemes for illumination and electrical equipment of buildings or in electrical distribution H.V. and M.V. Technical training to O.N.C. standard or equiv. an advantage. Salaries up to £850 p.a. Starting pay dependent upon age, quals., and experience. Paid overtime. Long term possibilities with pensionable and promotion prospects. Natural born British subjects. Write stating age, quals., employment details including type of work done to any Employment Exchange quoting Borough and relevant Order No. G 624

THE ELECTRICITY CORPORATION OF NIGERIA

requires the following staff for service in Nigeria. Some of the appointments are pensionable, others are on contract terms with gratuity payable at end of service.

Intending candidates should write to the undernoted address stating which appointment they are interested in, when full details regarding attractive rates of pay and conditions of service, together with an application form, will be forwarded. Please note that all applicants must possess a clean U.K. Motor Driving Licence.

ELECTRICAL ENGINEERS.

Must be corporate members of I.E.E.

OVERHEAD LINESMAN.

A man with first class experience able to work without supervision and at distance from H.Q. Must have proved ability to control labour.

METER TEST ENGINEERS.

With first class experience in laboratory testing of motor and electrical instruments and ability to work alongside and supervise junior staff.

STOREKEEPERS.

With good experience in the electrical supply industry. Knowledge of generating, steam, diesel and distribution stores. Some experience of Shipping and Customs procedure desirable.

ACCOUNTANTS.

One senior post for which the candidate must be Chartered or Incorporated Accountant. The Junior post calls for experience of supply industry accounts up to trial balance.

THE LIAISON OFFICER,
ELECTRICITY CORPORATION OF NIGERIA,
11, MANCHESTER SQUARE,
LONDON, W.1. K 304

UNIVERSITY OF GLASGOW.

LECTURESHIP IN CIVIL ENGINEERING.

Applications are invited for a Lectureship in Civil Engineering. Salary Scale: £650 by £50 to £1350. Initial salary according to experience and qualifications. F.S.S.U. and family allowance benefits. Applicants should hold an Honours degree in Engineering.

Applications (8 copies) should be lodged, not later than 14th April, 1956, with the undersigned, from whom further particulars may be obtained.

ROBT. T. HUTCHESON,
Secretary of University Court. K 840

UNIVERSITY OF GLASGOW.

ASSISTANTSHIP IN CIVIL ENGINEERING.

Applications are invited for an Assistantship in Civil Engineering. Salary Scale: £550-£650. Initial salary according to experience and qualifications. F.S.S.U. and family allowance benefits.

Applications (3 copies) should be lodged, not later than 14th April, 1956, with the undersigned, from whom further particulars may be obtained.

ROBT. T. HUTCHESON,
Secretary of University Court. K 841

METROPOLITAN BOROUGH OF WANDSWORTH.

SENIOR ASSISTANT ENGINEER.

Applications invited for this established post (Grade APT. V, £825 rising to £1000 p.a.) from persons experienced in heating, ventilating, electrical, and mechanical engineering. Application forms from Borough Engineer to be returned to me as soon as possible.

R. H. JERMAN,
Town Clerk.
Municipal Buildings,
Wandsworth, S.W.18. K 853

MINISTRY OF SUPPLY requires **ASSISTANT FACTORY MANAGER** at Radway Green, near Crewe, for large flow production of small arms ammunition. Qualifications: British of British parents. Recognised apprenticeship and A.M.I.Mech.E. or E.E. or equivalent. Must be well experienced S.A.A. production, or controlled inspection, and control of skilled and semi-skilled staff. Knowledge industrial training method an advantage. Salary: Within £1055-£1335 p.a.—Application forms from M.L. & N.S., TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting C41/6A. K 908

PITMAN TECHNICAL BOOKS

THE SUPERVISOR'S GUIDES. No. 4 Factory Organization. By J. Munro Fraser, M.A., and B. W. Gould, M.I.Prod.E., A.M.I.E.E. This book is the latest addition to a very popular series. It forms a concise guide to factory management produced specially in suitable form for supervisors and foremen. 3s. net.

BOILER PLANT TECHNOLOGY

By R. L. Batley, O.B.E., A.M.I.Mech.E., and E. Gordon Barber, B.Sc.Hons. (Lond.), A.R.I.C., F.R.P.S. 3rd Edition. This book embodies the results of research made co-operatively by an engineer and a chemist and thus approaches the subject from a scientific as well as from an engineering angle. This new edition has been revised and extended to cover fully the modern developments in the subject. Illustrated. 28s. net.

THE PROTECTIVE GEAR HANDBOOK

By M. Kaufmann, M.I.E.E. A companion volume to "The Switchgear Handbook." The book is invaluable to engineers interested in maintaining continuity of supply in distribution networks, to those responsible for planning and designing switchgear installations, and also to students. 35s. net.

FACTORY ADMINISTRATION IN PRACTICE

By W. J. Hiscox and James Stirling, A.M.I.Mech.E. 6th Edition. This book has been widely adopted throughout the country by educational institutions as a textbook for classes in factory administration and organisation. An invaluable book for all members of the factory administrative staff. 12s. 6d. net.

PLANNING, ESTIMATING AND RATE-FIXING

By A. C. Whitehead. 3rd Edition. Deals with the theory and practice of rate-fixing, time studies, process and shop planning, etc. The book is invaluable to practical factory men and all who are interested in the mechanics of production. 16s. net.

PRACTICAL SHEET AND PLATE METAL WORK

By the late E. Arthur Atkins. 6th Edition, revised by W. A. Atkins. Illustrated. 20s. net. "The popularity of this book may be gauged from the fact that this is the sixth edition of a work which first appeared over forty years ago—to the amateur, the student and the professional, this book will be found invaluable."—THE METAL BULLETIN.

SIR ISAAC PITMAN & SONS LTD.
Parker Street, Kingsway, London, W.C.2

WOLVERHAMPTON AND STAFFORDSHIRE TECHNICAL COLLEGE.
Principal: C. L. OLD, B.Sc.(Eng.), M.Sc.Tech.

DEPARTMENT OF PRODUCTION ENGINEERING AND MANAGEMENT.

Applications invited for **LECTURER** to teach Mathematics and Mechanics in National Certificate courses. Ability to teach other H.N.C. Production subjects a recommendation. Candidates should have appropriate professional qualifications and industrial experience.

Salary in accordance with Burnham Technical Report £965-£1065.

Further particulars and forms of application from undersigned (s.a.e.).

G. W. R. LINES,
Clerk to the Joint Education Committee.
Education Offices,
North Street,
Wolverhampton. K 867

COUNTY BOROUGH OF WEST HAM.

EDUCATION COMMITTEE.

WEST HAM COLLEGE OF TECHNOLOGY, ROMFORD ROAD, E.15.
Principal: E. A. RUDGE, M.Sc., Ph.D., F.R.I.C., A.M.I.Chem.E.

Applications are invited from graduates with industrial and teaching experience for appointment as **LECTURER IN CIVIL ENGINEERING** to teach up to University Degree and Higher National Certificate standard.

Salary: Burnham (London) Scale, at present £965 by £25 to £1065 per annum, plus London Allowance.

Application forms and particulars obtainable from the Principal.

R. OPENSHAW,
Chief Education Officer.
Education Offices,
95, The Grove,
Stratford, E.15. K 851

CYPRUS.
WATER DEVELOPMENT DEPARTMENT.

EXECUTIVE ENGINEERS, CLASS II.

DUTIES: Investigations, surveys, design and construction of miscellaneous water development works, including conservation, irrigation, drainage, town and rural water supplies, etc.

APPOINTMENT: On Contract/Gratuity terms for 4 years. Gross emoluments in scale £1080-£1440 plus cost-of-living allowance. Substantial gratuity payable on satisfactory completion of agreement. Free passages. Free medical attention. Generous home leave. Candidates should possess a University degree in civil engineering recognised as exempting from or have passed final Parts I and II of the Institution of Civil Engineers examination and have had several years experience in civil engineering works.

For full details apply in writing to DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, S.W.1, giving brief details of age, qualifications and experience. Quote reference BCD 140/17/03/D5. K 844

AUSTRALIA.
UNIVERSITY OF SYDNEY.

The Senate will shortly proceed to an appointment to the **LAWRENCE HARGRAVE CHAIR OF AERONAUTICAL ENGINEERING.**

Salary will be at the rate of £A3000 per annum, plus cost-of-living adjustment (£A31 men, £A23 women). There is a normal retirement provision under the Professorial Superannuation Scheme, and in addition, a pension of not less than £A400 per annum upon retirement after the age of sixty years.

Finance is available for home purchase under Staff Members' Housing Scheme. The Senate reserves the right to fill the Chair by invitation.

Further particulars and information as to the method of application may be obtained from the SECRETARY, ASSOCIATION OF UNIVERSITIES OF THE BRITISH COMMONWEALTH, 36, GORDON SQUARE, LONDON, W.C.1.

The closing date for the receipt of applications, in Australia and London, is 7th MAY, 1956. K 842

STATES OF JERSEY.

SEWERAGE BOARD.

Applications are invited for appointments in the office of the Consultant Engineer to the Sewerage Board, as follows:—

(*a*) **AN ASSISTANT ENGINEER** at a commencing salary within the range £900 to £1000 a year. The principal duties will be the design of trunk sewers in connection with the Island Main Drainage Scheme and applicants should be competent to handle all phases of such work up to the tendering stage. Applicants should preferably be between 25 and 35 years of age and have passed sections A and B of the Institution of Civil Engineers examination or have some equivalent qualification.

(*b*) **TWO DRAUGHTSMEN** at a commencing salary within the range £400 to £500 a year. Applicants should be competent draughtsmen able to plot surveys and make finished drawings from dimensioned sketches. Ability to take levels and a knowledge of surveying would be an advantage. One appointment will be for general drawing office duties in connection with the design of new works, while in the case of the other the principal duties will involve taking measurements, plotting and making records of works.

The appointments will be temporary and terminable by one month's notice on either side.

Applications, stating age, whether married or single, giving full details of training, qualifications, present and previous appointments and accompanied by copies of two recent testimonials, must be delivered not later than 30th April, 1956, to the GREFFIER OF THE STATES, STATES' GREFFE, JERSEY, C.I.

The States of Jersey can undertake no responsibility for the provision of housing accommodation. K 920A

Classified Advertisements continued on Page 4

THE ATOMIC WEAPONS RESEARCH ESTABLISHMENT, ALDERMASTON, BERKSHIRE,

requires an

ENGINEER (BASIC GRADE) AND A TECHNICAL ASSISTANT,

to assist in a section engaged in the Engineering Design of Nuclear Energy Devices. Applicants should hold 1st or 2nd class Honours Degree in Engineering and/or Corporate Membership of one of the senior Engineering Institutions or have exempting qualifications. Experience in undertaking experimental testing involving test bed layout instrumentation is desirable.

Salary: Engineer £728-£1130 per annum. Technical Assistant £508-£873 per annum. Contributory Superannuation Scheme. Successful married officers now living outside the Establishment's transport area will be eligible for housing on one of the Authority's estates. Alternatively assistance towards legal expenses incurred in house purchase may be available, until housed a lodging allowance may be payable.

Requests for application forms by Postcard to SENIOR RECRUITMENT OFFICER at the above address, quote reference 1090/26 not later than 12th April, 1956. K 919

LONDON COUNTY COUNCIL.

ARCHITECT'S DEPARTMENT.

Applications are invited from

PERSONS WHO HAVE SUCCESSFULLY COMPLETED A COURSE OF STUDY which is recognised by the Institution of Civil Engineers as exempting them from Final Parts I and II of the Institution's examination and who are prepared to serve for two years under agreement in the Structural Engineering Division in order to complete their practical training as required by the Institution of Civil Engineers.

Candidates must be not more than 25 years of age. The starting salary will be in the scale £620-£817. There are two vacancies.

Application forms, returnable by 16th April, 1956, from THE ARCHITECT (AR/EK/GSE/2), COUNTY HALL, S.E.1. (519) K 885

THE NIGERIAN RAILWAY CORPORATION invite applications for appointment as

ASSISTANT ENGINEER in the Civil Engineering Department to take charge of a sub-District or medium sized capital works. Applicants should preferably have had approved experience in Railway Engineering, including bridge, and general building construction, and possess initiative, sound judgment and strong physique. They should be Corporate Members of the Institution of Civil Engineers or possess an Engineering degree recognised as granting exemption from Sections I and II of the A.M.I.C.E. examination.

Appointment will be either on probation in a permanent post in the salary range £850-£1600 plus £300 overseas inducement pay per annum or on Contract in the same range plus a gratuity based on 20 per cent. of the total salary plus overseas pay payable at the end of each tour of satisfactory service, or on final completion of service. The point of entry will be dependent on age, qualifications and experience.

Terms of service provide for tours of fifteen months, free first class passages both ways for the selected candidate and his wife, annual maintenance allowance of £75 each in respect of a maximum of two children while in United Kingdom, or actual cost of their passages if under 18 years of age, part furnished quarters at low rental and the grant of leave at the rate of seven days per completed month of service. Outfit allowance of £60.

Applications should be addressed to the LONDON REPRESENTATIVE, NIGERIAN RAILWAY CORPORATION, 11, MANCHESTER SQUARE, LONDON, W.1, giving personal particulars, qualifications and experience. K 883

CENTRAL ELECTRICITY AUTHORITY.
EASTERN DIVISION.

Applications are invited for the following appointments in the Generation (Construction) Department at Divisional Headquarters in North London:—

CIVIL AND STRUCTURAL DESIGNER DRAUGHTSMEN.

Salary N.J.B., Schedule "D," within the range of Grades 3/4, £787 by £20 to £1008 per annum including London Weighting.

The commencing salary will depend on experience and qualifications.

The candidates appointed will be required to undertake civil and structural design work, and applicants should have had experience in the design and detailing of reinforced concrete structures for heavy plant, culverts, etc., and structural steelwork as applied to industrial buildings.

Applications stating age, qualifications and experience should be sent to the CONTROLLER, CENTRAL ELECTRICITY AUTHORITY, EASTERN DIVISION, NORTHMET HOUSE, SOUTHGATE, N.14.

W. N. C. CLINCH,
Controller. K 881

THE ROYAL TECHNICAL COLLEGE, GLASGOW.
(Affiliated to the University of Glasgow.)

DEPARTMENT OF MECHANICAL, CIVIL, AND CHEMICAL ENGINEERING.

CHAIR OF CIVIL ENGINEERING.

The Governors of the Royal Technical College, invite applications for the Chair of Civil Engineering tenable in the Department of Mechanical, Civil, and Chemical Engineering. The salary attached to the Chair is £1900 by £100 to £2200. Particulars of the appointment and forms of application may be obtained from the SECRETARY-TREASURER, GEORGE STREET, GLASGOW, C.1. K 897

CITY OF CARDIFF EDUCATION COMMITTEE. COLLEGE OF TECHNOLOGY AND COMMERCE. (Principal: A. HARVEY, Ph.D., B.Sc., F.Inst.P.)

ENGINEERING DEPARTMENT.

Applications are invited for the post of **ASSISTANT LECTURER, GRADE B,** duties to commence 1st September, 1956.

Candidates should hold a recognised qualification in Mechanical or Production Engineering and should state in their application which subjects they are qualified to teach.

Salary: £525-£820, plus training and graduate allowances. Initial salary depends on previous experience.

Further particulars and forms of application may be obtained from the undersigned on receipt of a stamped addressed foolscap envelope and forms should be returned without delay.

ROBERT E. PRESSWOOD,
Director of Education.

City Hall,
Cardiff. K 899

GOVERNMENT OF CYPRUS.

CHIEF INSPECTOR OF FACTORIES (MALE OR FEMALE) required to organise and supervise the observance of labour legislation relating to workplaces, to conduct legal proceedings when necessary, prepare reports and train subordinate staff. Sound experience in Supervisory capacity of the application of United Kingdom factory laws and regulations required with, preferably, engineering qualifications of degree standard.

Post permanent and pensionable or on three-year contract. Salary scale £1353 to £1634 plus 10 per cent. cost-of-living allowance, and, if on contract a gratuity. Quarters at low rental. Free passages. Generous leave. Free medical attendance. Low Income Tax.—Further particulars and application forms from DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, GREAT SMITH STREET, S.W.1, quoting BCD 132/17/01. Closing date for the receipt of initial enquiries May 5th, 1956. K 900

ADMIRALTY.
ROYAL NAVAL SCIENTIFIC SERVICE.

ENGINEERS AND PHYSICISTS (PARTICULARLY WITH ELECTRONICS) required in Experimental Officer and Assistant Experimental Officer grades in Experimental Establishments in London, Portsmouth, Weymouth areas, Cheltenham and Scotland. Candidates must normally be natural born British subjects of natural born British parents, with minimum of H.S.C. (Pass degree, H.N.C. or near equivalent an advantage). London salary: (men) E.O. £790-£960, A.E.O. £320 10s.-£700 (according to age). Appointments unestablished, but opportunities to compete for established posts.—Application forms from M.L. & N.S., TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting A214/5A. K 907

ENGINEERS AND PHYSICISTS (minimum age 26) required by MINISTRY OF SUPPLY, ROCKET PROPULSION DEPARTMENT, WESTCOTT, BUCKS, for research and development on rocket motors and propellants; instrumentation and recordings; investigations on high speed flow and heat transfer problems. Qualifications: H.S.C. (Science) or equivalent but pass degree or H.N.C. may be an advantage. Salary within Experimental Officer range £745-£920.—Application forms from M.L.N.S., TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1. quoting A 105/6A/BG. Closing date 21st April, 1956. K 901

ENGINEER required at MINISTRY OF SUPPLY HEADQUARTERS, LONDON, to supervise preparation of scientific and technical papers by Headquarters branches, Experimental Establishments and industry on design requirements for Guided Weapons and to assist in arranging extension of existing weapon trials programmes. Candidates should have a 1st or 2nd class honours degree or equivalent qualification in Engineering and experience appropriate to above duties. Appointment according to age, experience, etc., as Senior Scientific Officer (minimum age 26 with at least 3 years post-graduate research experience) or Scientific Officer (minimum age 21). Salary within ranges S.S.O. £1070-£1245; S.O. £513 10s.-£925 (superannuable).—Application forms from M.L.N.S., TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting D117/6A. Closing date 14th April, 1956. K 903

NORTH WEST METROPOLITAN REGIONAL HOSPITAL BOARD.

The Board are engaged on a number of new building and engineering projects, including a new hospital at Welwyn, and the following staff are required to fill a number of newly created posts on the establishment of the Regional Engineer.

ASSISTANT ENGINEERS — ELECTRICAL, MECHANICAL, HEATING AND VENTILATING

Applicants must be at least (*a*) Graduate members of the Institution of Electrical Engineers, and have passed the Institution examination (lately the Associate membership examination) or recognised exempting examinations; or (*b*) Graduate members of the Institution of Mechanical Engineers, and have passed Sections A and B of the Associate membership examination, or recognised exempting examinations; or (*c*) Graduate members of the Institution of Heating and Ventilating Engineers, and have passed the Associate membership examination, or recognised exempting examinations.

Salary scale: £640 by £25 (4) by £30 (4) by £35 (2) to £930 plus £20-£40 London Weighting.

ENGINEERING ASSISTANTS

Applicants must have O.N.C. or other approved qualification in appropriate engineering subjects.

Salary scale: £480 (age 21 and over) by £20 (7) by £25 (2) to £670 plus £20-£30 London Weighting.

Posts are subject to Whitley Council conditions and are superannuable. Starting salaries may be above minimum having regard to extent of experience since obtaining appropriate qualifications.

Apply, stating which post and giving age, qualifications (with dates) and experience, together with the names and addresses of two referees, to SECRETARY, NORTH WEST METROPOLITAN REGIONAL HOSPITAL BOARD, 11a, PORTLAND PLACE, LONDON, W.1. K 847

MINISTRY OF SUPPLY requires

ENGINEERS at PYESTOCK, HANTS, to assist in planning, design and installation of heavy test plant connected with gas turbine design and development. Qualifications: British of British parents. Recognised engineering apprenticeship and A.M.I.C.E. or Mech.E. or E.E. or exempting qualifications. Hons. degree in engineering advantageous. Experience in design, construction, erection of heavy plant essential. Salary: Within £675 (age 25)-£1055.—Application forms from M.L.N.S., TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting C244/6A. K 902

STRUCTURAL ENGINEERS urgently required.

(*a*) **SENIOR ASSISTANT** experienced in design of steelwork for buildings. Must be A.M.I.Struct. Engineer or equivalent. Salary: APT. V £795-£970, or APT. VI, £880-£1080.

(*b*) **ASSISTANTS** experienced in detailing of steelwork for buildings, educational standard Graduate Inst. Structural Engineers or equivalent. Salary: APT. IV, £710-£885.

Alternate Saturdays free, canteen facilities.

Application forms may be obtained from the COUNTY ARCHITECT, BISHOPGARTH, WESTFIELD ROAD, WAKEFIELD, and should be returned within ten days of the publication of this advertisement. K 852

ENGINEERS (SENIOR AND MAIN GRADES)

required by

THE ATOMIC WEAPONS RESEARCH ESTABLISHMENT, ALDERMASTON, BERKSHIRE.

To lead or assist in a section engaged in engineering design of nuclear energy devices. Considerable experience in the undertaking and supervising experimental testing involving test bed layout and instrumentation, etc., is essential and candidates must have had experience in one or more of the following fields:—

(1) Heat transfer problems.
(2) High temperature fluid pumping.
(3) Strength of materials at elevated temperatures.

Applicants should hold 1st or 2nd class Honours Degree in Engineering and/or Corporate Membership of one of the Senior Engineering Institutions or have wide engineering experience backed by academic qualifications in Physics or Chemical Engineering.

Salary: Senior Grade £1490-£1685. Main Grade £1130-£1435 per annum.

Contributory Superannuation Scheme. Successful married officers now living outside the Establishment's transport area will be eligible for housing on one of the Authority's estates; alternatively assistance towards legal expenses incurred in house purchase may be available.

Requests for application forms by Postcard to SENIOR RECRUITMENT OFFICER at the above address, not later than 14th April, 1956, quote reference 1091/26. K 918

PERSONAL

MR. J. MILWAIN, M.I.Prod.E., has been employed by David Brown & Sons, Ltd., Park Gear Works, Huddersfield, for nearly 30 years, latterly in the capacity of Chief Inspector and Chief Works Superintendent in the Heavy and Light Engineering Divisions. He has recently been in South Africa where he has been employed by David Brown Precision Equipment (Pty) Ltd., Benoni, Transvaal, in a technical capacity, in particular as Production Engineer. He is returning by air to England on 14th February. Please note his future address will be "Sunnydene," Spurn Lane, Diggle, nr. Oldham. K 474

APPOINTMENTS OPEN.

THE ENGAGEMENT OF PERSONS answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 inclusive or a woman aged 18-59 inclusive unless he or she, or the employment, is excepted from the provision of the Notification of Vacancies Order 1952.

It is advisable when sending testimonials to forward copies and NOT originals.

The following appointments are available in

THE ATOMIC ENERGY DEPARTMENT

of

THE GENERAL ELECTRIC COMPANY LIMITED

at Erith, Kent

for development and Design work on

NUCLEAR POWER STATIONS

Ref. A.E.D.1

MECHANICAL ENGINEERS with experience in the design and layout of large steam Power Stations. Applicants should have a degree in Engineering and not less than five years experience in this type of work.

Ref. A.E.D.2

A MECHANICAL ENGINEER with a first or second class honours degree who has specialised in stress analysis problems in complex steel structures.

Ref. A.E.D.3

MECHANICAL ENGINEERS, preferably with honours degrees, who have had experience in heat transfer research and heat exchanger design.

Ref. A.E.D.4

A MECHANICAL ENGINEER, preferably with a degree and with experience in the development of prototype mechanisms, to take charge of a laboratory where reactor control and fuel element handling equipment is now being tested.

Ref. A.E.D.5

DESIGNER-DRAUGHTSMEN with experience in Power Station layout, heat exchanger and pressure vessel design, and the design of mechanical control equipment and servo mechanisms.

Attractive salaries will be offered and the positions available afford excellent opportunities for advancement.—Apply giving age and details of training and experience to PERSONNEL MANAGER, THE GENERAL ELECTRIC CO., LTD., FRASER & CHALMERS ENGINEERING WORKS, ERITH, KENT. K 466

THE RESEARCH DEPARTMENT OF METROPOLITAN-VICKERS ELECTRICAL CO., LTD., TRAFFORD PARK, MANCHESTER, 17, has a further vacancy for an

ENGINEER OF HIGHER NATIONAL CERTIFICATE STANDARD or equivalent for practical research and development, in the laboratory and in the works, of a wide variety of machining processes. Some initial training will be given where necessary.

Write for application form to: PERSONNEL MANAGER, METROPOLITAN-VICKERS ELECTRICAL CO., LTD., TRAFFORD PARK, MANCHESTER, 17. Quote reference J.4. G 641

DRAUGHTSMEN (MECHANICAL) required by RANSOME & MARLES BEARING CO., LTD., NEWARK-ON-TRENT, NOTTS. The work is both interesting and varied, covering an extremely wide field of engineering, therefore we invite Senior Draughtsmen with a sound and widest possible mechanical experience to apply, the conditions of working are very good, full welfare facilities, including a staff superannuation scheme, are in operation, some housing accommodation is also available, the posts offered are permanent, with ample scope for advancement, and the salary is commensurate with ability and experience.

Apply Secretary, giving full details, age, experience and salary required. K 502

ELECTRICAL DRAUGHTSMAN, AGE 30-35, of at least National Certificate in Electrical Engineering standard. Permanent position with pension scheme. Applicant should be capable of working with minimum supervision, and be conversant with equipment layout, schematic and main connection diagrams, and ordering of electrical equipment. Estimating experience would be an advantage. Applications to COWANS, SHELDON & CO., LTD., CRANE MANUFACTURERS, CARLISLE, with particulars of experience and salary required. K 79

WANTED.

SALES REPRESENTATIVES in many areas with engineering background a knowledge of conveyors advantageous but not essential. Must have good appearance and sales experience. Good salary; expenses; car provided.—Reply giving past record to BOX K 849, Offices of ENGINEERING.

SHORT BROTHERS AND HARLAND LIMITED

THE MECHANICAL SECTION

of the

RESEARCH DEPARTMENT

has vacancies for

SENIOR DEVELOPMENT ENGINEERS, DEVELOPMENT ENGINEERS AND TECHNICAL ASSISTANTS

for

work on guided missiles and navigational systems, automatic pilots, flight simulators, servos and automatic control developments. Applicants should preferably have had some experience of hydraulic or pneumatic servos, precision mechanisms, or systems employing such components.

QUALIFICATIONS: Senior Engineers: Engineering Degree, with several years suitable experience, and the ability to control a development team. Engineers: Degree or equivalent, with some industrial experience. Technical Assistants: H.N.C. or equivalent, with good practical experience in appropriate field.

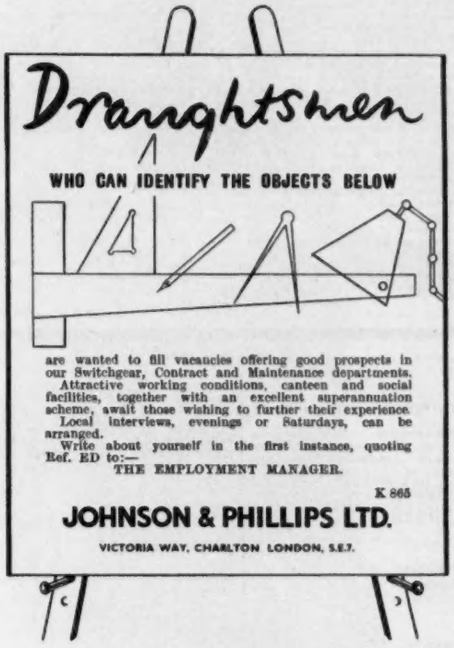
Assistance with housing and with removal expenses.

Interview either in London or Belfast.

Apply to:—

STAFF APPOINTMENTS OFFICER,
SHORT BROTHERS & HARLAND LIMITED,
P.O. BOX 241, BELFAST, quoting S.A.134, and stating salary required.

K 864



are wanted to fill vacancies offering good prospects in our Switchgear, Contract and Maintenance departments.

Attractive working conditions, canteen and social facilities, together with an excellent superannuation scheme, await those wishing to further their experience.

Local interviews, evenings or Saturdays, can be arranged.

Write about yourself in the first instance, quoting Ref. ED to:—

THE EMPLOYMENT MANAGER.

K 865

JOHNSON & PHILLIPS LTD.

VICTORIA WAY, CHARLTON LONDON, S.E.7.

McGRAW-HILL *some interesting recent books*

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94s ***T. M. Matson, W. S. Smith and F. W. Hurd***
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ASTE DIE DESIGN HANDBOOK
109s ***American Society of Tool Engineers***
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THE NEW AMERICAN MACHINIST'S HANDBOOK
67s 6d ***Rupert Le Grand***
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McGRAW-HILL *from your usual bookseller*

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD ARMAMENTS DIVISION

PROJECT ENGINEERS

and

ASSISTANT PROJECT ENGINEERS

Vacancies exist for qualified

MECHANICAL, ELECTRO-MECHANICAL and AERONAUTICAL ENGINEERS

who will be responsible for the technical co-ordination of engineering design and development between the specialist Design Groups, within and outside the firm.

The fields covered include the mechanical and structural design of airframes, servo control systems, weapon power supply systems, ground and handling gear and all associated equipment.

Men of degree standard with experience in the general field of Engineering and the ability to analyse engineering problems are invited to apply for senior posts.

Previous experience is not essential for the more junior positions but a similar technical standard and outlook is necessary.

These positions are responsible posts and carry attractive salaries and excellent prospects.

Pleasant working conditions and amenities are provided and an attractive superannuation scheme is in operation.

All replies should be addressed to:—

TECHNICAL APPOINTMENTS OFFICER,
SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD.,
BAGINTON, Nr. COVENTRY.
quoting Reference Pr/8/ARM/TAO.

K 859

Classified Advertisements continued on Page 6

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD.
ARMAMENTS DIVISION.

Invite applications for the following vacancies in the Assessment Group.

(1) **A MECHANICAL OR AERONAUTICAL ENGINEER** with an interest in vibration problems and aero-elastic studies.

Qualifications should include a degree, and previous experience in this type of work is desirable but not essential.

(2) **TECHNICIANS.**

5 Technicians are required for analysis and interpretation of flight test results.

The essential qualifications would be an Honours degree in Mathematics or Physics, and while previous experience is desirable it is not essential.

(3) **MATHEMATICIANS OR MATHEMATICAL PHYSICISTS.**

2 Mathematicians or Mathematical Physicists are required for interesting work in the Assessment and Aerodynamic Sections.

Applicants should possess a 1st or 2nd class Honours degree, and while previous experience is not essential it would be an advantage.

(4) **TECHNICAL ASSISTANTS.**

A number of Technical Assistants are required for interesting work in the Analysis Section.

The essential qualifications for these posts would be G.C.E. in Maths. or Physics and preferably one year's further schooling in Maths. or Physics.

All these posts offer an interesting and permanent career, together with attractive salaries and opportunities for advancement.

Excellent working conditions and amenities are provided, and an attractive superannuation scheme is in operation. All replies should be addressed to :—

TECHNICAL APPOINTMENTS OFFICER,
SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT, LTD.,
BAGINTON, NR. COVENTRY.
Quoting reference A/2/ARM/TAO. K 330

NUCLEAR INSTRUMENT DEVELOPMENT.

DESIGN-DRAUGHTSMAN wanted for responsible pioneer work on nuclear instrument development in small department. Preferably H.N.C. Salary according to qualification and experience.—Apply PERSONNEL OFFICER, PHILIPS BALHAM WORKS, LTD., 45, NIGHTINGALE LANE, LONDON, S.W.12. Tel. BAT. 8521. K 898

PRODUCTION ASSISTANT required with engineering qualifications.—Write stating age, experience and salary required, BOX K 910, Offices of ENGINEERING.

DRAUGHTSMANSHIP. 12 months' course in our modernly equipped Training Department to qualify for entry into one of our Drawing Offices: Engine, Chassis, Body, Styling, Research, Stress Analysis, Tooling, etc. Attractive salary, one day weekly college training, four-year contract. Qualifications: Preferably G.C.E. at "O" level in Maths, Physics, and English, or equivalent technical education. Maximum age 27 years.—Apply in writing, stating age, education, practical experience, nationality, married or single, to THE TECHNICAL TRAINING DEPARTMENT, AUSTIN MOTOR CO., LTD., LONGBRIDGE, BIRMINGHAM. K 911

DRAUGHTSMEN.

Applications are invited from **EXPERIENCED MECHANICAL ENGINEERING AND DESIGN DRAUGHTSMEN** to be the nucleus of a newly-formed Central Engineering and Planning Department to deal with expansion projects and new development work for the whole of the Pilkington Group of Companies at home and overseas.

Minimum starting salaries for Draughtsmen of H.N.C. standard range between £678 at age 25, to £800 at age 35, plus agreement and staff bonuses for which they become eligible after one year's service. Conditions include contributory Superannuation Fund, assisted house purchase and family education schemes.

Reply, stating age, qualifications and experience, to the GROUP CHIEF ENGINEER, PILKINGTON BROTHERS, LIMITED, ST. HELENS, LANCASHIRE. K 846

ENGINEER—SALES ENGINEER, under 28 and single, preferably G.I.Mech.E. or Grad.I.E.E. with experience of sales of a wide range of engineering products required by a British Company in North Borneo. Remuneration according to qualifications and experience, but not less than £1000 p.a. plus annual bonus. First contract four years carries six months paid home leave. Outfit allowance, Pension Scheme and Provident Fund.—BOX E 884, Offices of ENGINEERING.

THE DE HAVILLAND ENGINE COMPANY LIMITED

makers of the
"Super Sprite" and "Spectre" Rocket Engines,
have vacancies in their fast expanding

ROCKET DIVISION

If you are a first class:

DESIGNER

DETAIL DESIGNER

CHECKER, TRACER

OR

DEVELOPMENT ENGINEER

and would like to discuss your prospects with us, either write to:—

THE PERSONNEL OFFICER,
THE DE HAVILLAND ENGINE COMPANY LIMITED,
STAG LANE, EDGWARE, MIDDLESEX,

or call any Saturday morning between 10 o'clock and 12 noon—no appointment is necessary.

Here is your opportunity to obtain an interesting, well paid and progressive job on projects of national importance.

K 863

NUCLEAR PROJECTS GROUP

Applications are invited from

Young men with Initiative and Imagination

to work at Harwell on one of the most advanced nuclear reactor projects now being studied.

(1) MATHEMATICAL PHYSICIST

to carry out nuclear calculations on core and shield.

(2) APPLIED MATHEMATICIAN

to investigate control problems. Knowledge of servo-mechanisms theory desirable.

(3) CERAMIST

to develop high temperature fuel elements and ceramic coatings.

(4) PROJECT DRAUGHTSMAN

for preliminary layout work. Knowledge of steam or gas turbines desirable.

Background in the Aircraft Industry or Reactor Engineering an advantage but not essential.

Salaries of up to £1000 per year offered depending on qualifications, age and experience. Selected candidates for posts (1) and (2) will attend 3-month course at the A.E.R.E. Reactor School (value £250).

Apply giving fullest details of career to:—

THE DE HAVILLAND ENGINE COMPANY LIMITED,
c/o A.E.R.E.,
HARWELL, BERKSHIRE. K 87 8

Foundry Plant manufacturers require **SENIOR DRAUGHTSMEN** with mechanical handling and/or structural experience for highly mechanised Cupola melting plants.—Full details in confidence to: PERSONNEL MANAGER, INCANDESCENT HEAT CO., LTD., CORNWALL ROAD, SMETHWICK, 41. K 848

GRADUATE IN CHEMICAL ENGINEERING OR CHEMISTRY required for work on problems associated with pilot scale gasification plant. Previous experience in an industrial laboratory an advantage. Starting salary £680-£940 per annum according to age and qualifications. Grading and Superannuation Schemes.—Apply in writing to ASSISTANT SECRETARY, REF. C.9/10, B.C.U.R.A., RANDALLS ROAD, LEATHERHEAD, SURREY. K 597

A rapidly expanding Light Engineering Organisation with a modern Factory convenient to London and near the East Coast is seeking **EXPERIENCED YOUNG MEN AS DESIGN AND JIG AND TOOL DRAUGHTSMEN.** The prospects are excellent, the position is pensionable and any accommodation problem can be overcome. Apply in first instance giving full details of age, experience and salary required to the Employment Officer, BOX K 598, Offices of ENGINEERING.

SENIOR DRAUGHTSMEN for electro-mechanical devices required. Varied and interesting work.—Apply CHIEF DRAUGHTSMAN, NASH AND THOMPSON, LTD., OAKCROFT ROAD, CHESSINGTON, SURREY. 'Phone Elmbridge 1252. K 596

WILTON ICI WORKS

MECHANICAL ENGINEERS

FOR ENGINEERS DIRECT from the University, or for trained Mechanical Engineers with industrial experience, the chemical industry provides opportunities for a satisfying and well paid career. At Wilton during the last ten years many plants of great technical interest have been erected and plans made for further continuous development over a number of years. Here there are vacancies for Engineers on design, construction, and operation, with opportunities for training and advancement to managerial positions.

THE CHANCE TO take part in this enterprise should particularly attract men graduating in 1956. Starting salaries are good and, should it be necessary, there are opportunities of gaining practical experience in a course which will initiate men into industry and be acceptable to the chartered engineering institutions.

THIS MODERN factory is situated at the foot of the Cleveland Hills within easy reach of the Yorkshire Coast. Working conditions are excellent and recreational facilities including golf, tennis and squash are available. After joining the staff, married men will receive a reasonable refund of removal (including travel) expenses; to assist in house purchase, facilities are available in approved cases for loans; in addition, legal charges may be advanced.

THE APPOINTMENTS are permanent and include membership of the Staff Pension Fund and participation in the Employees' Profit Sharing Scheme.

ANY ENGINEERING GRADUATE who is interested in a career which will combine interesting and productive work with prospects of steady progress should write to: STAFF MANAGER, IMPERIAL CHEMICAL INDUSTRIES LIMITED, WILTON WORKS, MIDDLESBROUGH, YORKSHIRE, quoting advertisement reference ICI/X/285/b. K 594

IMPERIAL CHEMICAL INDUSTRIES LIMITED.

METALS DIVISION.

MATERIALS HANDLING DESIGN ENGINEERS :

(*a*) Applications are invited for the position of **DESIGN ENGINEER** to take charge of a section dealing exclusively with Materials Handling.

The successful applicant will be required to supervise the selection and/or design and purchase of mechanical handling of all types.

The work also involves advising on plant layouts in so far as they are influenced by handling methods.

The principal products manufactured by the Division are non-ferrous sheets, strip, wire, extrusions, and both military and sporting ammunition. The scope is considerable and the work is interesting and varied.

Applicants should possess a good honours degree or a suitable professional qualification. Previous experience is essential and a knowledge of Work Study desirable. An important requirement is that candidates should be capable of preparing clear and concise reports for presentation to Factory Management.

The salary is appreciable and is consistent with the degree of responsibility involved.

(*b*) Applications are also invited for an **ASSISTANT DESIGN ENGINEER** in the above section.

Candidates should possess an honours degree or a suitable professional qualification. Previous experience is desirable but not essential.

Financial assistance towards removal expenses is available for married men. Excellent conditions of employment include Staff Pension Fund, Employees' Profit Sharing Scheme, etc.—Application forms may be obtained from the STAFF MANAGER, I.C.I. METALS DIVISION, KYNOCH WORKS, WITTON, BIRMINGHAM, 6, quoting ENG/22/E. K 888

CANADA.

A British Company of world wide reputation engaged in the manufacture of gear producing machines, equipment and tools requires for the Canadian Company a

GENERAL MANAGER to control office administration, sales and manufacturing activities. Applicants should give full details of past experience, domestic commitments, etc. The selected candidate will be required to enter into an agreement for a period of employment and the Company will provide facilities for emigrating, including fares and out-of-pocket expenses.—Write BOX K 917, Offices of ENGINEERING.

CAPABLE ELECTRICAL DESIGNER AND DRAUGHTSMAN required, preferably to H.N.C. standard or equivalent; some mechanical experience an advantage for development on electrical application to Machine Tools. Five-day week, staff Pensions Scheme.—Write stating age and full experience to EMPLOYMENT OFFICE, ALFRED HERBERT, LTD., COVENTRY. K 839

THE AVIATION OF ELLIOTT BROTHERS (LONDON), LTD., has a number of vacancies for the following Technical Staff:—

1. **SENIOR ELECTRICAL AND MECHANICAL ENGINEERS** for the development of airborne electro-mechanical devices in the field of automatic control and instrumentation. Previous experience of instruments or small mechanisms is essential, and familiarity with aircraft requirements very desirable. Applicants should possess good academic and professional qualifications.
2. **DEVELOPMENT ENGINEERS** for work on aircraft instruments and systems, also ground test equipment for both production and maintenance.

The Aviation Division of the Company is rapidly expanding, offering a wide scope for the exercise of individual initiative. Equipments under development or in production include automatic pilots, fuel flowmeter systems, and a wide range of electrical and mechanical flight instruments.

Pension Scheme, Canteen facilities, Sports and Social amenities are available.

Please apply giving full details of age, experience and salary expected to PERSONNEL MANAGER, ELLIOTT BROTHERS (LONDON), LTD., AIRPORT WORKS, ROCHESTER, KENT. K 595

Are you looking for interesting and varied work connected with Design, Development, and Testing of a wide variety of new pieces of equipment for mechanical handling in Collieries and for Railway Signalling? We have vacancies for young men with ideas to work on mechanical, pneumatic and/or Electro mechanical projects.

Your are not expected to have had experience of this particular type of work, and training will be arranged where necessary for successful applicants. Some of the posts may well be filled by those with a few years' experience as a design draughtsman.

POSTS ARE AVAILABLE FOR GRADUATES OR FOR THOSE STILL STUDYING FOR THEIR NATIONAL CERTIFICATES IN MECHANICAL OR ELECTRICAL ENGINEERING and starting salaries will be in accordance with age, experience and qualifications. There is excellent scope for advancement for those with ability and initiative. Five-day week and pension scheme. For further information apply to PERSONNEL SUPERINTENDENT, WESTINGHOUSE BRAKE & SIGNAL CO. LTD., CHIPPENHAM, WILTS, quoting reference No. EQUIP/N/L. K 443

NUCLEONIC INSTRUMENT DEVELOPMENT. **ELECTRICAL ENGINEER** required. H.N.C. minimum qualifications with at least three years experience in electronics. Permanent appointment with interesting possibilities, depending mainly on the individual—Applications should be addressed to THE PERSONNEL OFFICER, PHILIPS BALHAM WORKS, LTD., 45, NIGHTINGALE LANE, S.W.12. G 639

SENIOR MECHANICAL AND STRUCTURAL DRAUGHTSMEN required in London office for the design, layout and detailing of Electric Cranes and Mechanical Handling for Steelworks.—Apply in writing, stating age and experience, to: "THE MECHANICAL DEPARTMENT," THE WELLMAN-SMITH-OWEN ENGINEERING CORPORATION, LTD., PARNELL HOUSE, WILTON ROAD, S.W.1. K 599

TANGYES LIMITED.

GENERAL WORKS MANAGER. The Company wish to appoint a Senior Executive Engineer, who, having proved himself suitable will be capable after a period of taking over the general control of the Works, including large iron foundry. Applicants should have wide experience of modern machining and assembly methods, Planning and Time Study for both batch and one-off production and labour control. Iron Foundry experience an advantage. The position offers excellent prospects. Pension Scheme available.—Applications, which will be considered in strict confidence, must give details of technical and practical training, past employment, age, etc., to be addressed to the ASSISTANT MANAGING DIRECTOR (ADMIN.) TANGYES LIMITED, CORNWALL WORKS, SMETHWICK, BIRMINGHAM. K 854

DRAUGHTSMEN

and

DESIGNERS

Applications are invited for the following positions on the regular Mechanical Engineering drawing office staff of a large iron and steel organisation:—

1. **DESIGNER**, fully experienced and accustomed to medium and heavy engineering equipment.
2. **SENIOR DRAUGHTSMAN**, with similar experience to the above.

There are also openings for draughtsmen of lesser seniority who have completed their National Service and have, including engineering training, not less than 5 years drawing office experience.

Nominal hours are 38 per week with payment for overtime to draughtsmen grades. A contributory superannuation fund is in operation.

Apply giving full particulars of engineering experience and training, also technical education and qualifications, stating salary required and when at liberty to BOX K 895, Offices of ENGINEERING.

Classified Advertisements continued on Page 8

PROGRESS IN ELECTRONICS

An experimental equipment used in research on television picture tubes.

Peep into the future

Nowhere in the world is the technical quality of British television surpassed. And this leadership will be maintained, for, despite present-day achievements, research goes on ceaselessly.

In television, as in other fields of electronics, Mullard scientists work hand in hand with the designers of Britain's leading setmakers. This combination is your assurance of the highest available standards of performance and quality. When you buy a receiver fitted with a Mullard picture tube, Mullard valves and magnetic components, you are sure of the best possible return for your money.

Mullard

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MULLARD LTD · CENTURY HOUSE · SHAFTESBURY AVENUE · LONDON W.C.2

MP5208

A.E.C. LIMITED require **DETAIL DRAUGHTSMEN.** Experience of the motor industry an advantage. Modern offices and equipment, excellent opportunities for progress. Good salary offered, five-day week, pension scheme and canteen facilities.—Applications in writing, giving age, experience and salary required to STAFF RECORDS OFFICE, WINDMILL LANE, SOUTHALL, MIDDLESEX. K 877

ENGINEERING SERVICES DRAUGHTSMAN required by AVON INDIA RUBBER CO., LTD., MELKSHAM, WILTS. Must be conversant with general services, design and layouts. This includes steam, hydraulic, compressed air, cooling water, space heating, etc. Sound opportunity for suitable man.—Applicants of H.N.C. standard or equivalent preferred, but others having the necessary experience are invited to apply to the CHIEF ENGINEER, with full particulars, age, etc. K 871

GENERAL ENGINEERING DRAUGHTSMAN required immediately in the Works Engineer's Department of THE AVON INDIA RUBBER CO., LTD., BRIDGEND. Permanent and sound position with expanding Company for a man who is prepared to work hard and adapt himself to growing industry with special purpose machinery and comprehensive engineering services. H.N.C. or equivalent. A.E.S.D. rates plus to suitable applicant.—Write, stating age, experience, etc., to PERSONNEL MANAGER. K 872

DESIGNER-DRAUGHTSMAN required with experience of Paper Converting and Aniline Printing Machinery. Ordinary or Higher National Certificate in Mechanical Engineering desirable. The work is varied and interesting, consisting mainly of development of existing plant.—Apply in writing stating age, experience and salary required to: DAILLEY AND COMPANY, LTD., GARMAN ROAD, NORTHUMBERLAND PARK, LONDON, N.17. K 873

ELECTRICAL LABORATORY ASSISTANT. Young men are required for prototype work on low voltage equipment for motor vehicles. Applicants should hold, or be studying for, O.N.C. (Electrical), although practical experience in similar work would be considered in its absence. Prospects of advancement into Design work exist for the right man.

Apply in writing giving full details of age and experience to PERSONNEL OFFICER, SIMMS MOTOR UNITS, LTD., OAK LANE, EAST FINCHLEY, N.2. K 886

THE BRITISH THOMSON-HOUSTON RESEARCH LABORATORY, RUGBY, require a **MECHANICAL OR ELECTRICAL ENGINEER** to assist in a programme of machining research with special reference to spark grinding and other applications of electro-erosion.—Applicants are invited to write to the DIRECTOR OF RESEARCH, BRITISH THOMSON-HOUSTON CO., LTD., RUGBY, giving details of age, qualifications and experience and quoting reference TJ. K 890

COST ACCOUNTANT required for Engineering Works at Speke, Liverpool. Age 35/45. Practical experience of standard costing essential. The post is pensionable with a good commencing salary and there are excellent prospects for an able man.—Reply, giving fullest information and an indication of salary to BOX K 330, LEE & NIGHTINGALE, LIVERPOOL. K 876

DRAUGHTSMEN required by NORTHERN ALUMINIUM COMPANY, LIMITED, BANBURY, OXON. Qualifications: H.N.C. preferred, but O.N.C. considered, workshop training an advantage. Permanent positions to suitable applicants. Pension and Life Assurance Scheme in operation, also welfare and sports facilities.—Applications in writing to PERSONNEL MANAGER, stating age, experience and salary required. K 856

IMPERIAL CHEMICAL INDUSTRIES LIMITED, PLASTICS DIVISION, has an immediate vacancy for a **DRAUGHTSMAN** for work on the instrumentation of chemical and plastics plants. Candidates should hold the Higher National Certificate in mechanical or electrical engineering. Some experience of industrial instrumentation would be useful.

A good starting salary will be paid, beyond which there is scope for progressive remuneration.—Apply giving full particulars to THE STAFF MANAGER I.C.I., LTD., PLASTICS DIVISION, BLACK FAN ROAD, WELWYN GARDEN CITY, HERTFORDSHIRE. K 850

QUALIFIED ENGINEER/AGENT required by firm of Industrial Engineers to supervise the erection of a large contract in the North West area. Applicants must have good organising and administrative experience. Previous steelworks engineering experience will be an advantage but not essential. Excellent permanent prospects are offered after completion of the specific contract which will be of three years duration. House will be provided.—Please state age, salary required and full particulars of previous experience to BOX K 843, Offices of ENGINEERING.

COURTAULDS LIMITED, COVENTRY, require **INSTRUMENT TECHNICIAN** for work on the design, installation and operation of experimental automatic control equipment in the textile and Chemical Engineering fields. Previous experience in at least one branch of Mechanical and Electrical Industrial Instrumentation is preferred, but a candidate with Electrical Design and Drawing Office experience would be considered eligible.

The post is an interesting one in the Research and Development Department and offers excellent prospects of promotion in a rapidly expanding field. Qualifications equivalent to a Higher National Certificate in Electrical or Mechanical Engineering are preferred.—Applications in the first instance to the LABOUR OFFICER, MAIN WORKS. K 855

TWO ENGINEERING DRAUGHTSMEN required by AVON INDIA RUBBER CO., LTD., MELKSHAM, WILTS, for mechanical equipment design work. Interesting and progressive situations offered to suitable applicants. H.N.C. standard or equivalent, but others with the necessary experience may apply to the CHIEF ENGINEER, with full particulars of age, etc. K 920B

Attractive Opportunities for Experienced Men

DAVY AND UNITED ENGINEERING COMPANY LIMITED

Due to our ever increasing production programme, Britain's largest builders of Rolling Mill and auxiliary plant offer the following vacancies to ambitious qualified men interested in heavy engineering. Every contract, whatever its size, has to be individually engineered so that the widest range of interest can be offered giving unlimited scope for ingenuity and initiative.

PROJECTS ENGINEERS — Engineers required with experience of blooming, structural and billet mills, and merchant bar and rod mills. The Projects Department covers the technical aspects of the Company's sales effort and the work involves the engineering for tendering purposes of customers enquiries, ranging from individual machines to complete mill plants.

GEAR ENGINEERS — Engineers required with experience in the design of heavy duty gears. The Gear Section is responsible for the design of a wide range of gears for all duties from small sizes up to 5,000 H.P.

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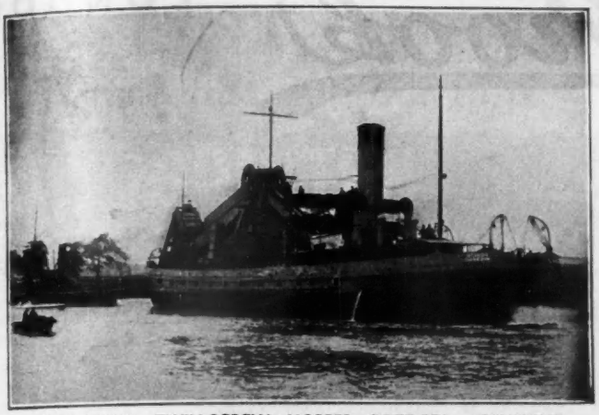
Classified Advertisements continued on Page 85



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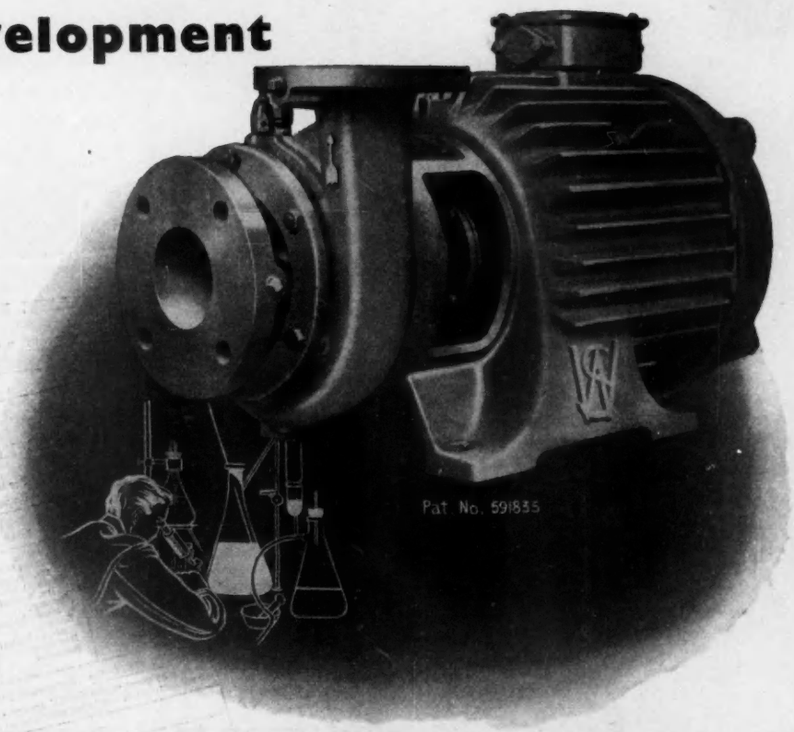

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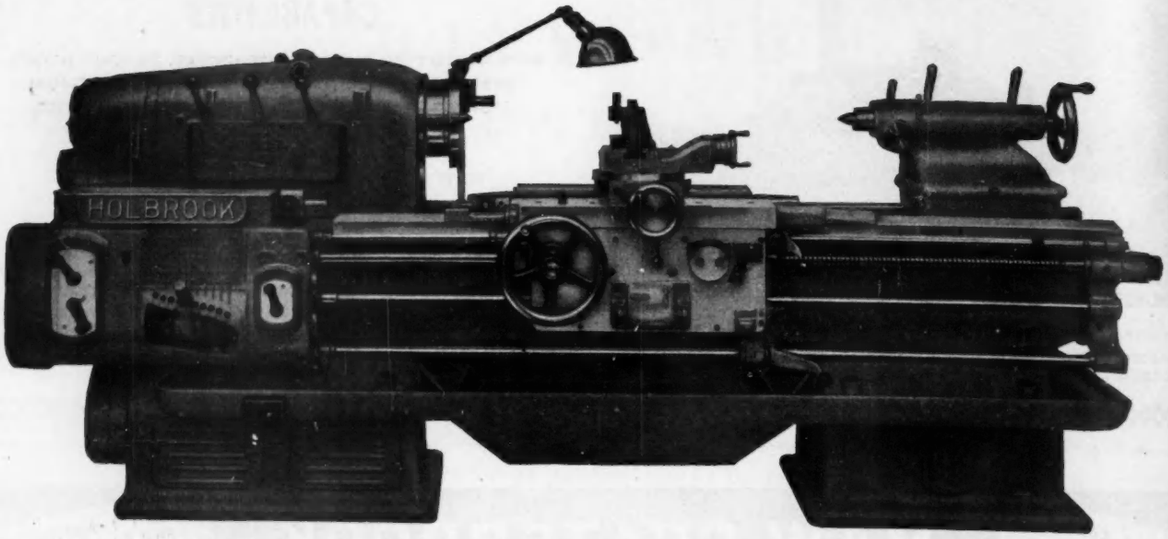

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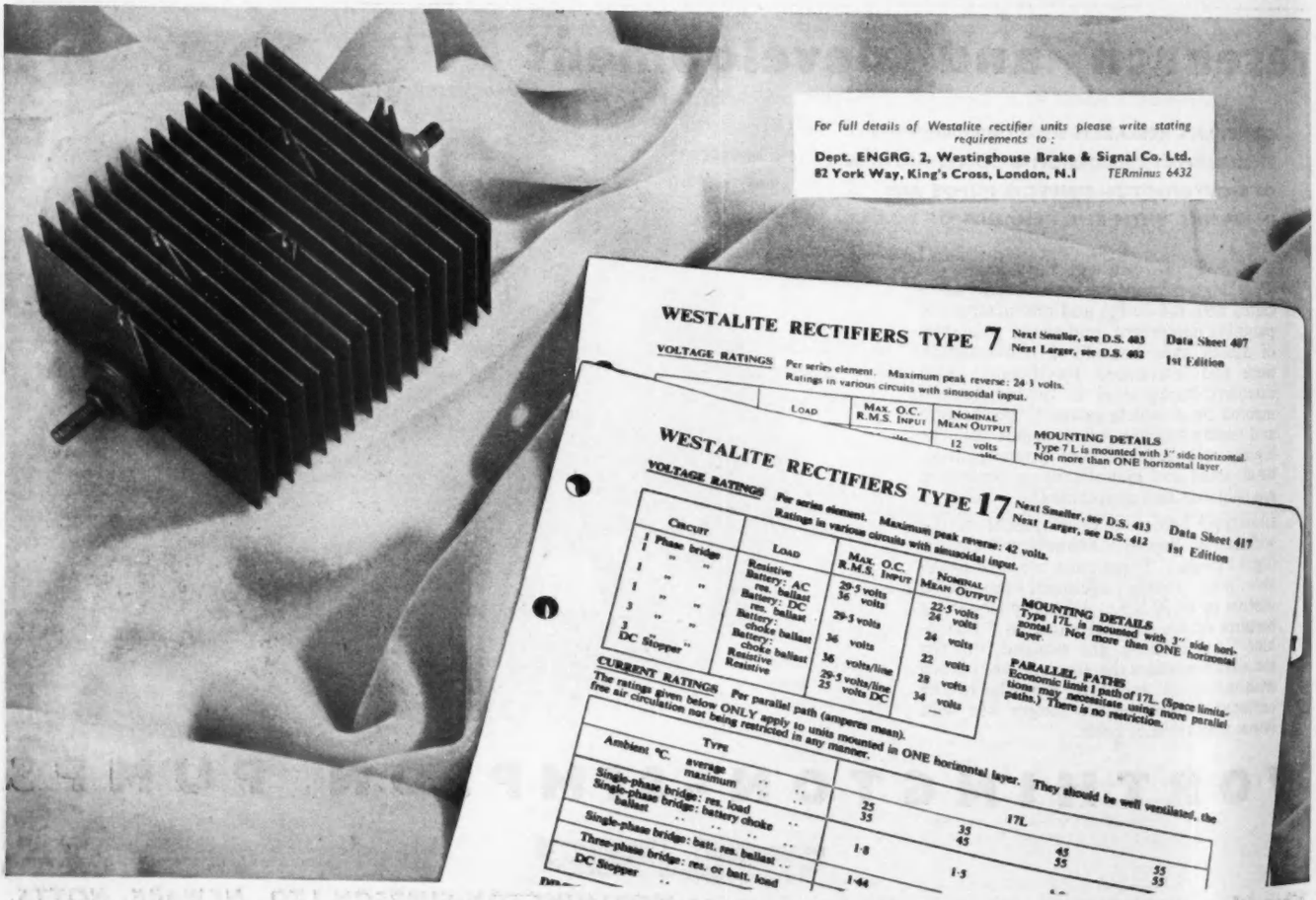
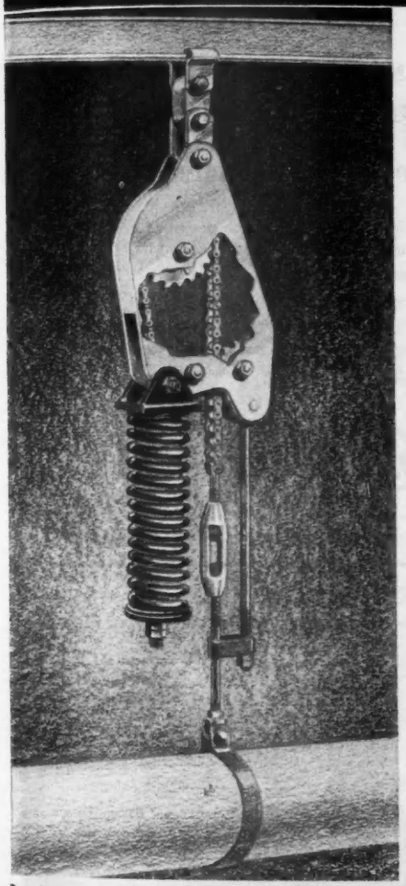


Fig 4

CONSTANT TENSION
–for loads up to 2 tons

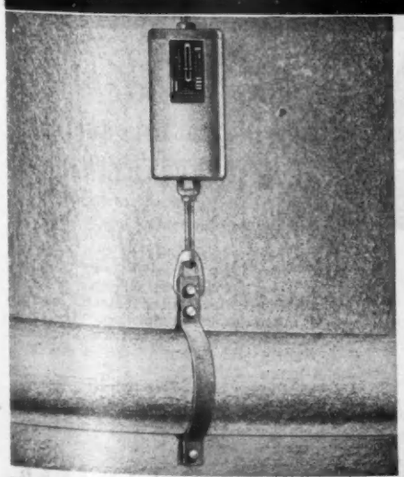
CON-TEN
CONSTANT TENSION PIPE SUPPORT



It is of great importance that expensive High Pressure Steam Pipes should not be subjected to excessive and unnecessary stresses. The "Con-Ten" Constant Tension Pipe Support overcomes the problem of wide variations of movement to the pipeline caused by expansion and contraction. Its simple but ingenious device specifically designed, allows high-temperature pressure piping equal and adequate support with every movement. Illustrated literature giving fuller details of this essential and economical support is available, please write, phone or call.

British Patent No. 474008
U.S.A. Patent No. 2129320

LEIBFRIED REDTOP PIPE SUPPORT



The Leibfried Redtop Pipe Support is not just a spring hanger, it also is a spring seat, the choice of either application being merely a matter of how the support is installed. This type of support will give pipe suspension designers far less trouble than other types in its application to the multitude of complex conditions confronting them from day to day. Redtop Pipe Supports are stocked in three standard model sizes providing for a supporting load of any value ranging from 100 to 5000 pounds and a total travel of 3 inches. Illustrated literature on request.

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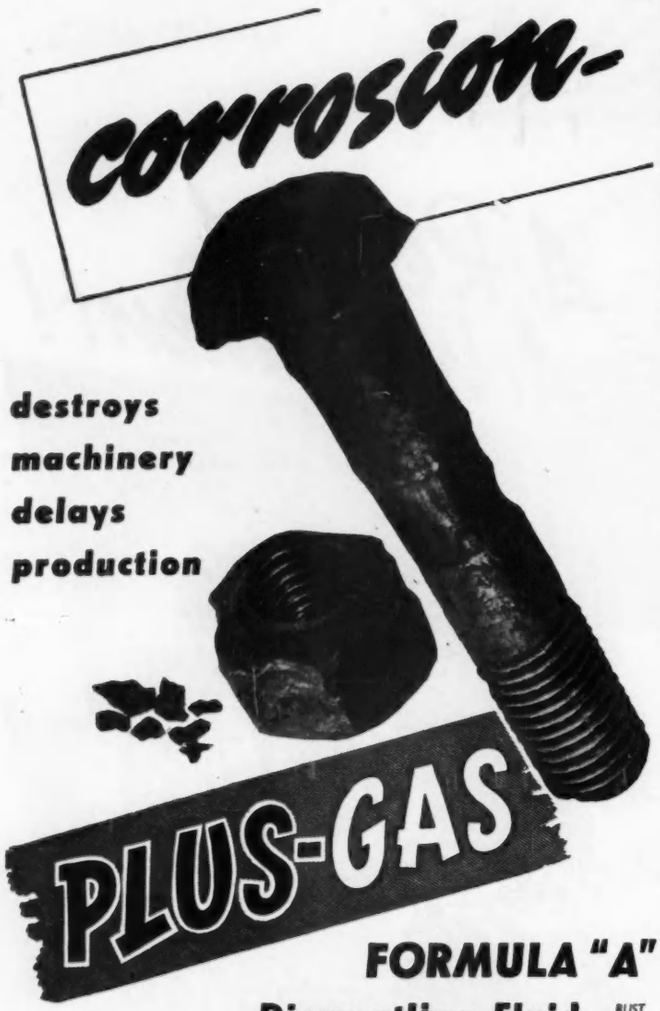

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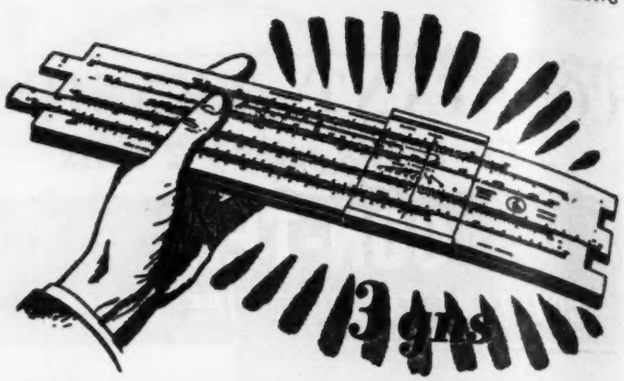

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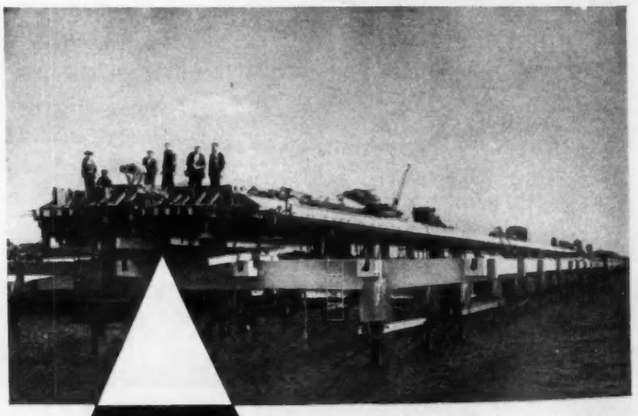

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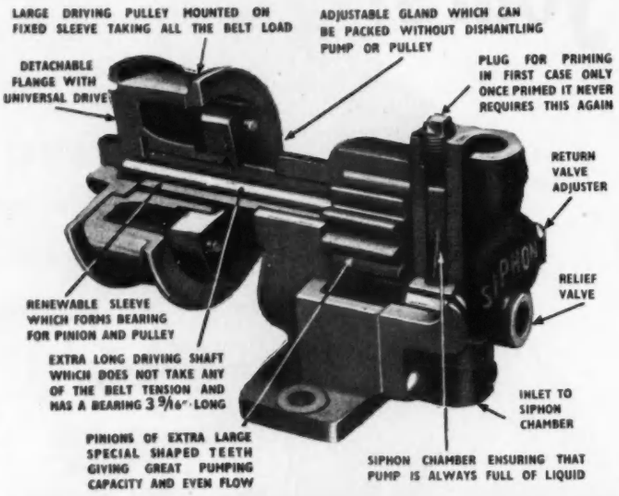
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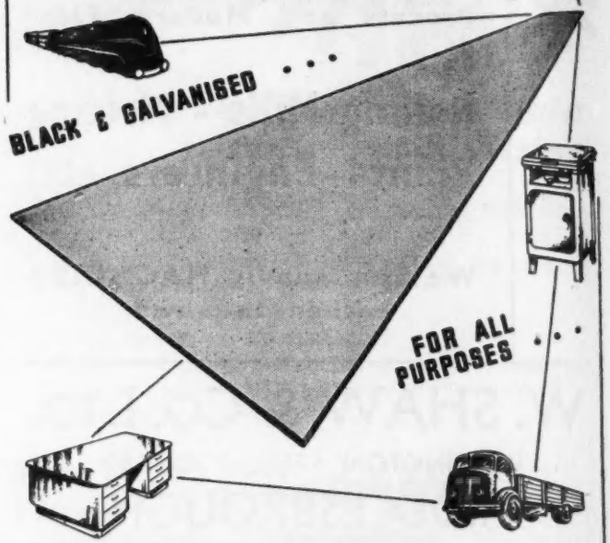

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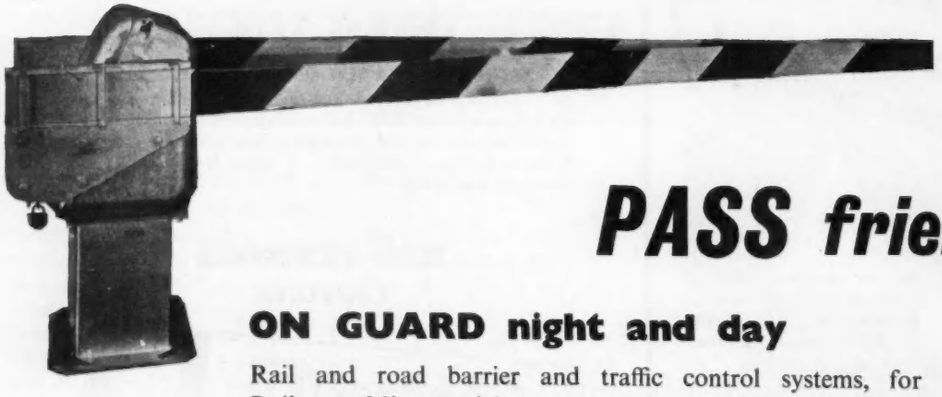

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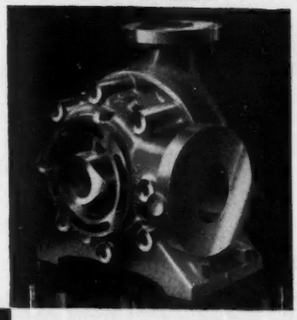

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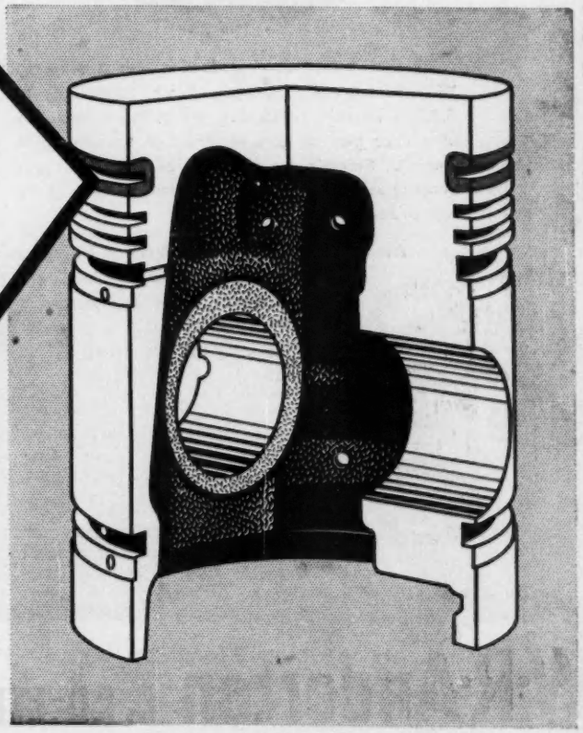

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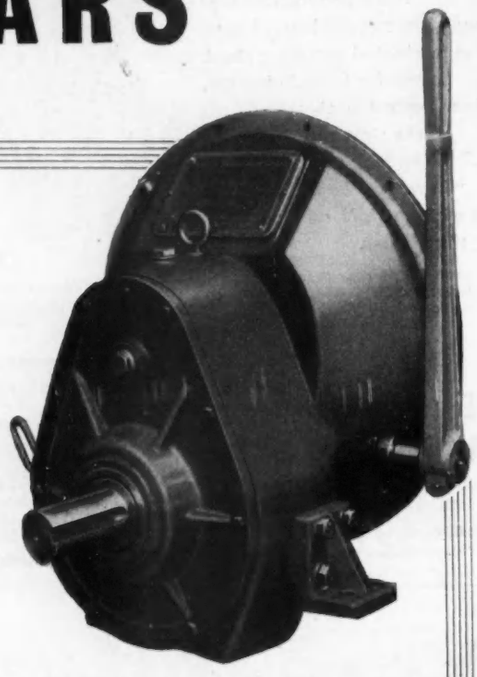

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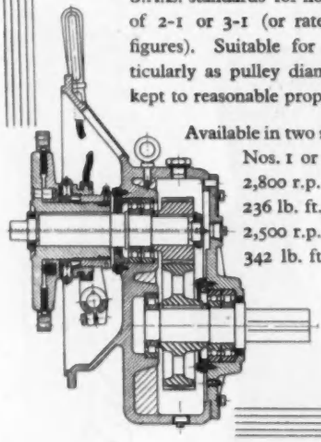

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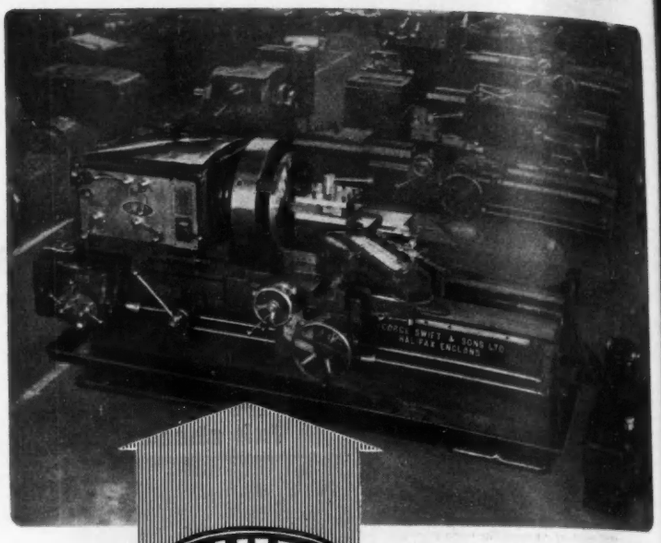

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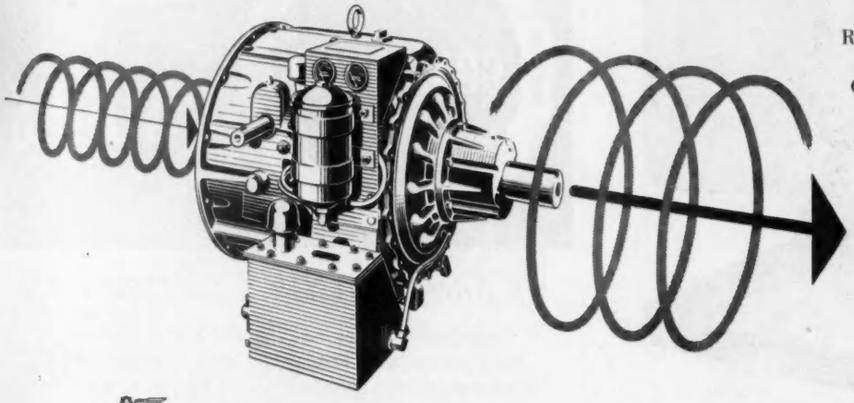

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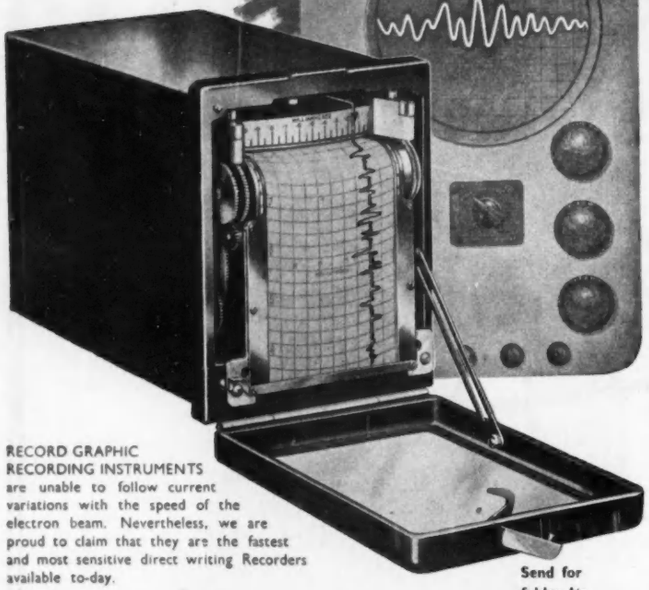

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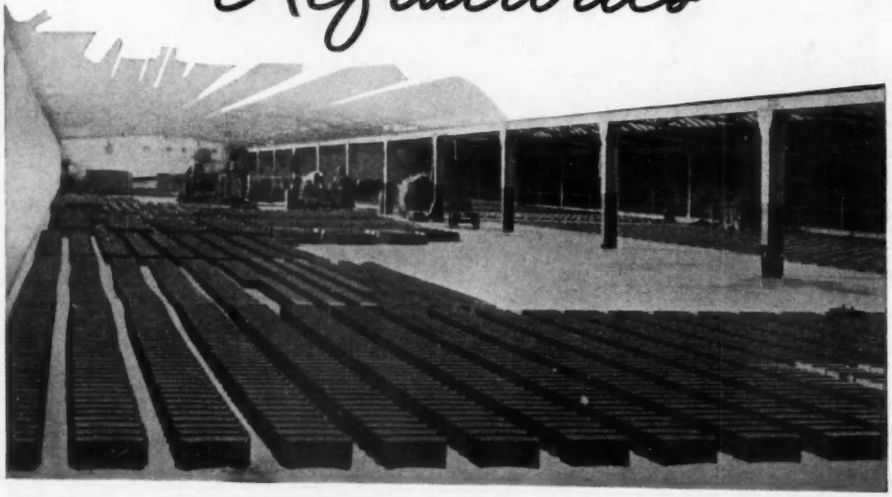

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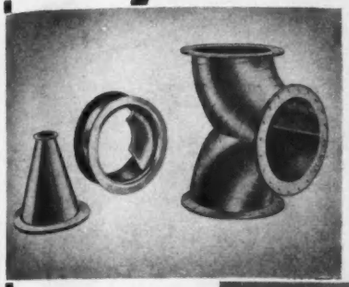

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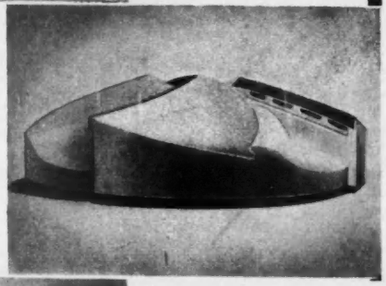

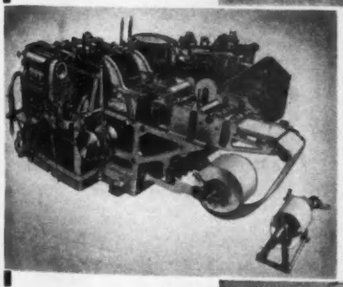

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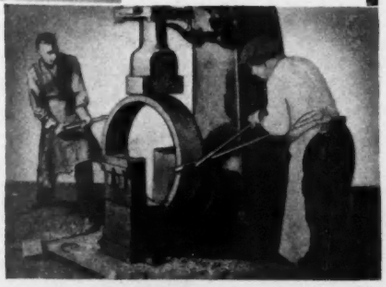

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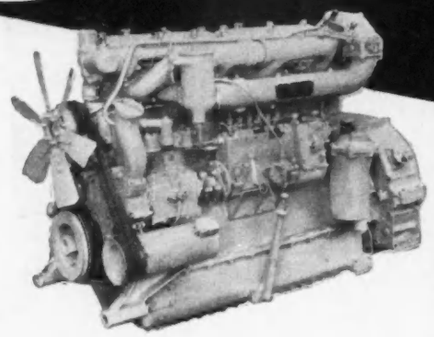

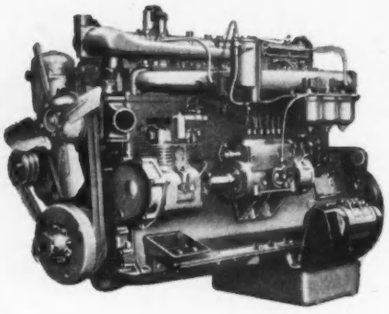

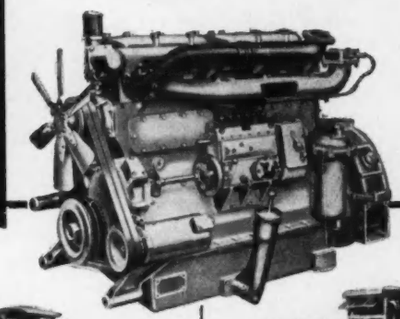

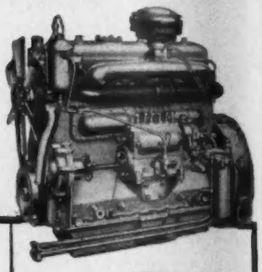

AVELING-AUSTIN 99-H all wheel drive graders utilising a U.E. 600 diesel.

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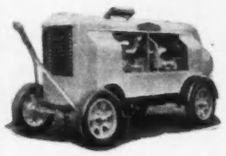

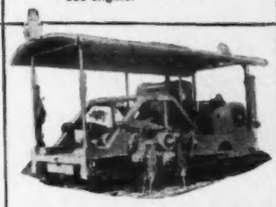

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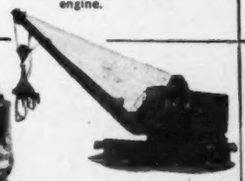
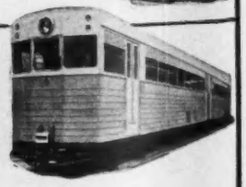
WINGET boom-type trencher, model 221, powered by U.E. 350 engine.

MITCHELL-FAILING M.1 transportable oil rig with Leyland U.E. 350 engine.





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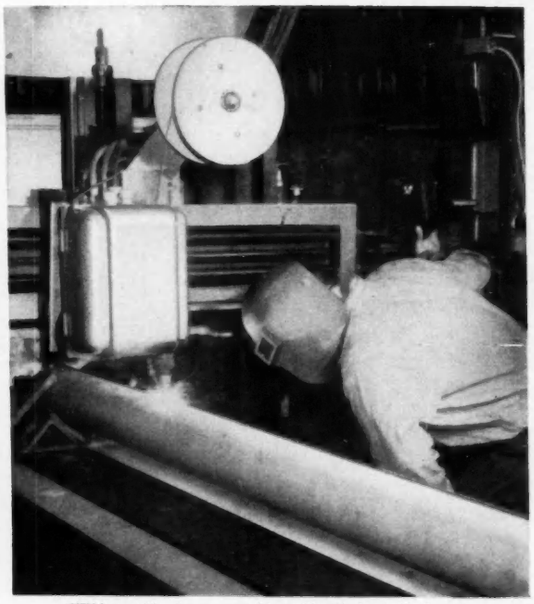

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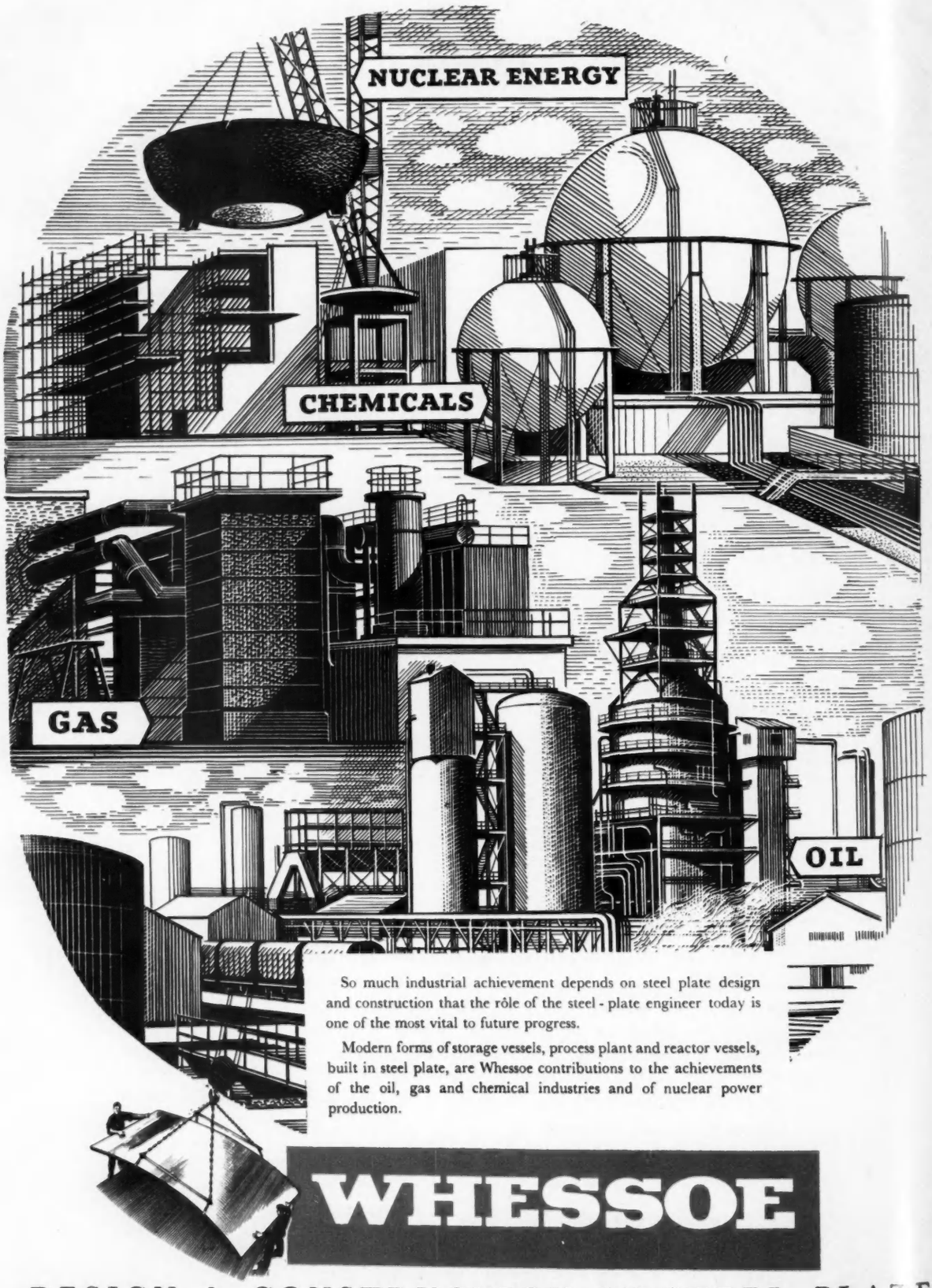

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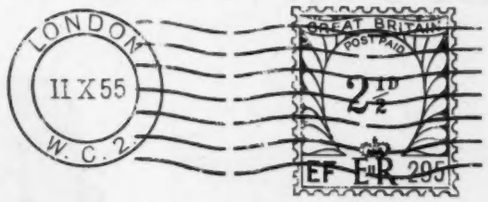

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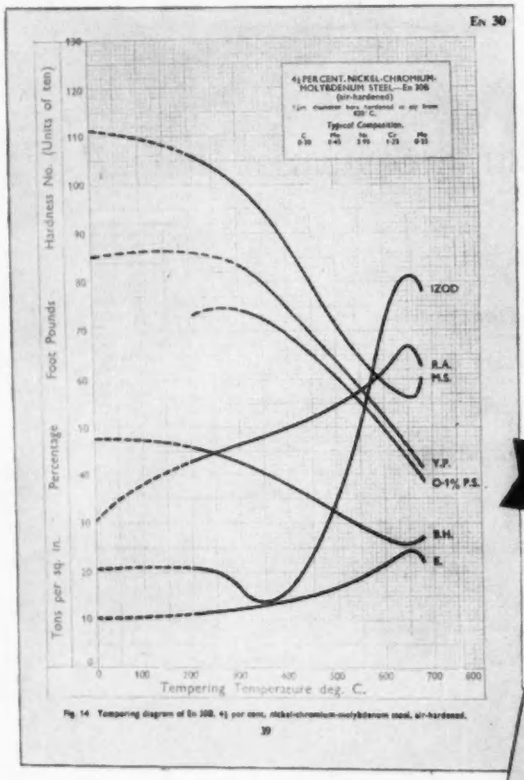
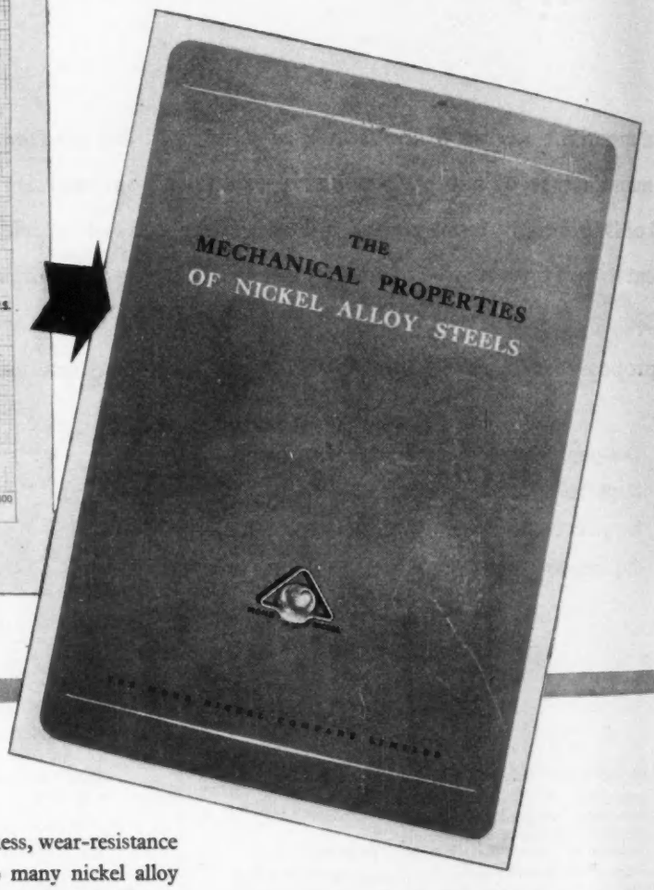


Fig. 14. Tempering diagram of En 30B, 4¼ per cent. nickel-chromium-molybdenum steel, air-hardened.

39



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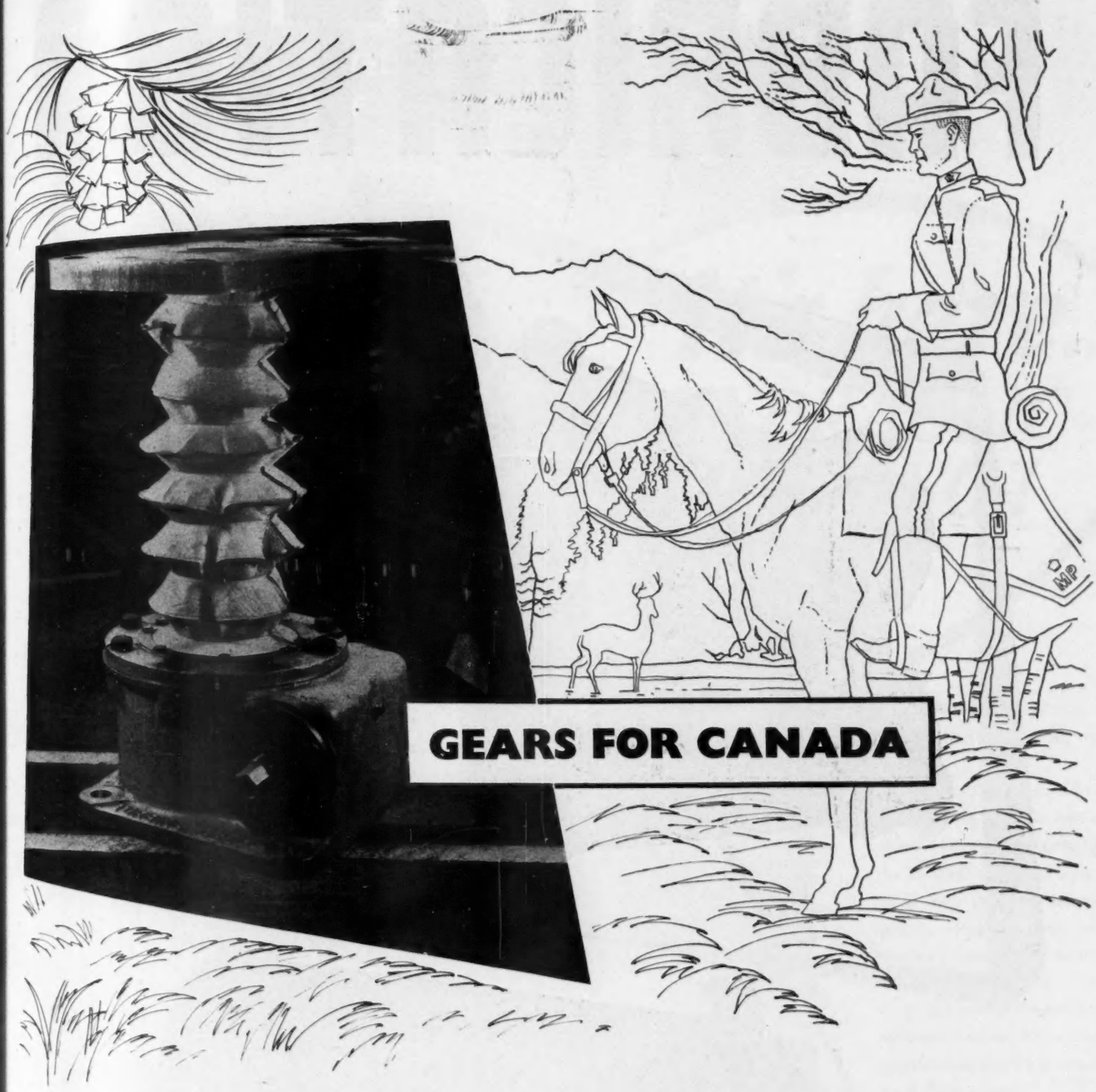

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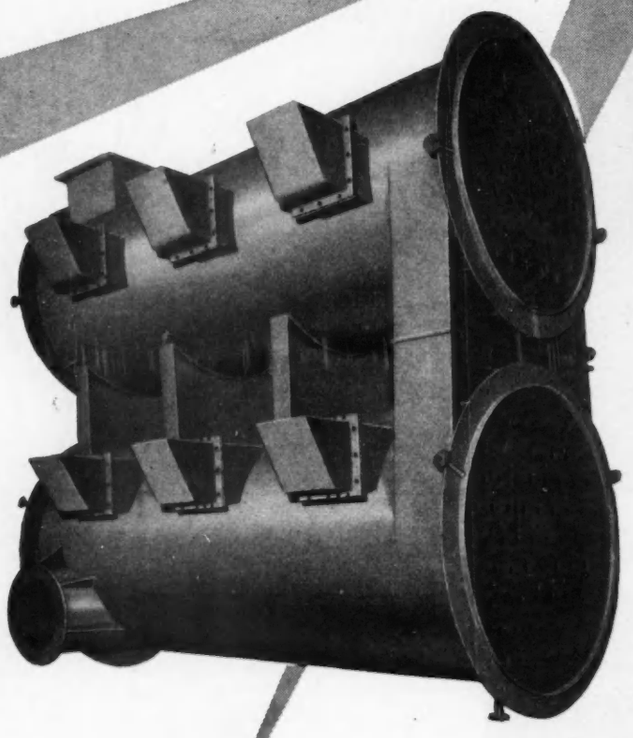

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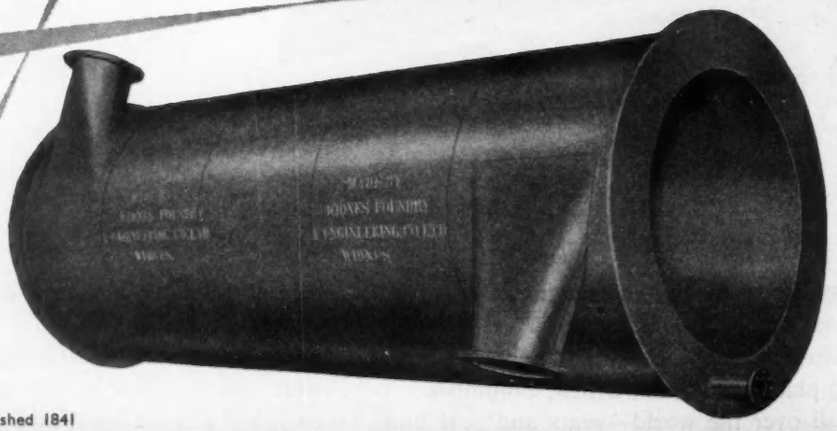
(BELOW) Mild Steel Helical cooler for SO_2, all welded construction; weight 6¾ tons, outer diameter 7 ft., inner diameter 6 ft., length 20 ft.



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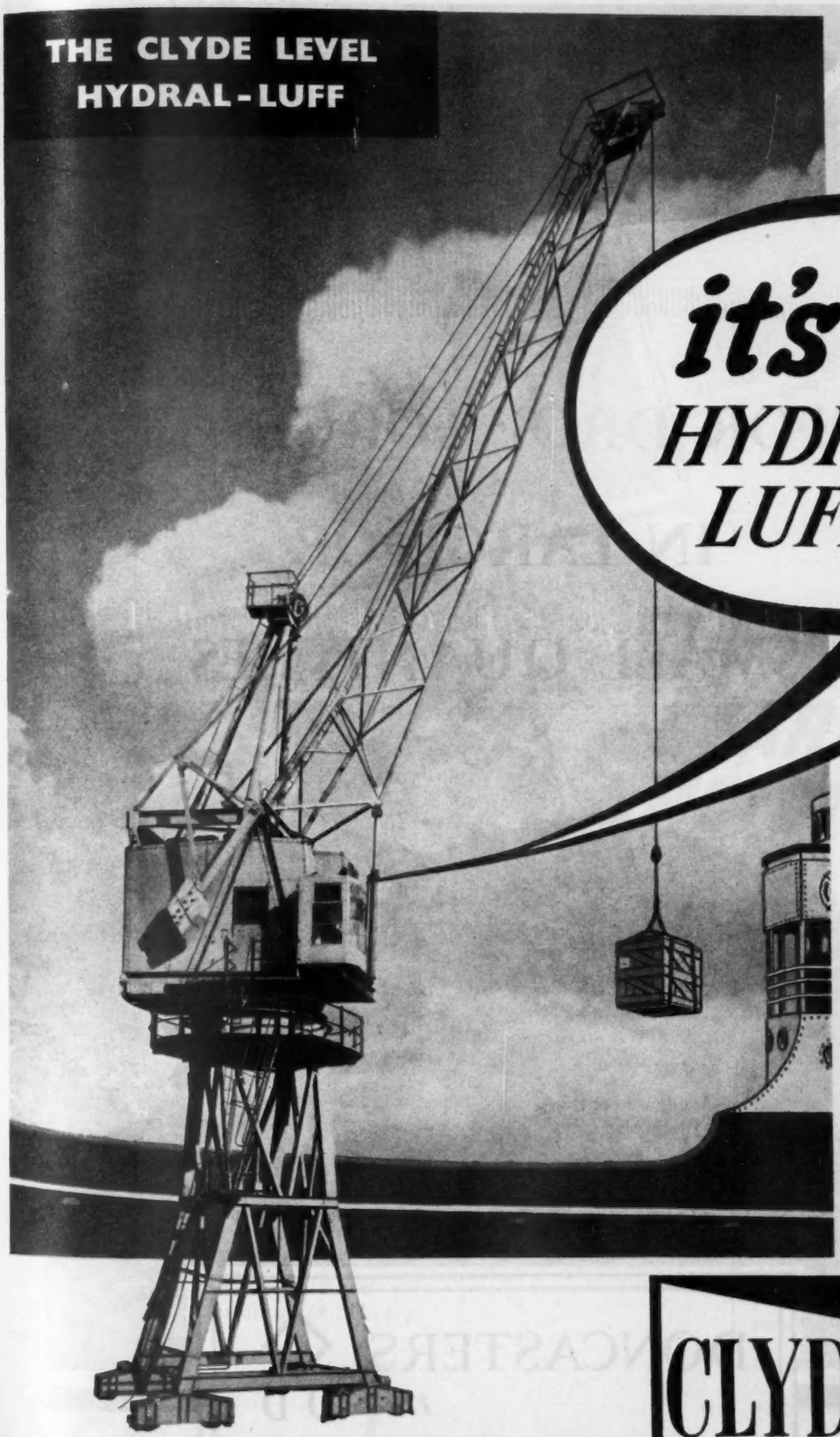

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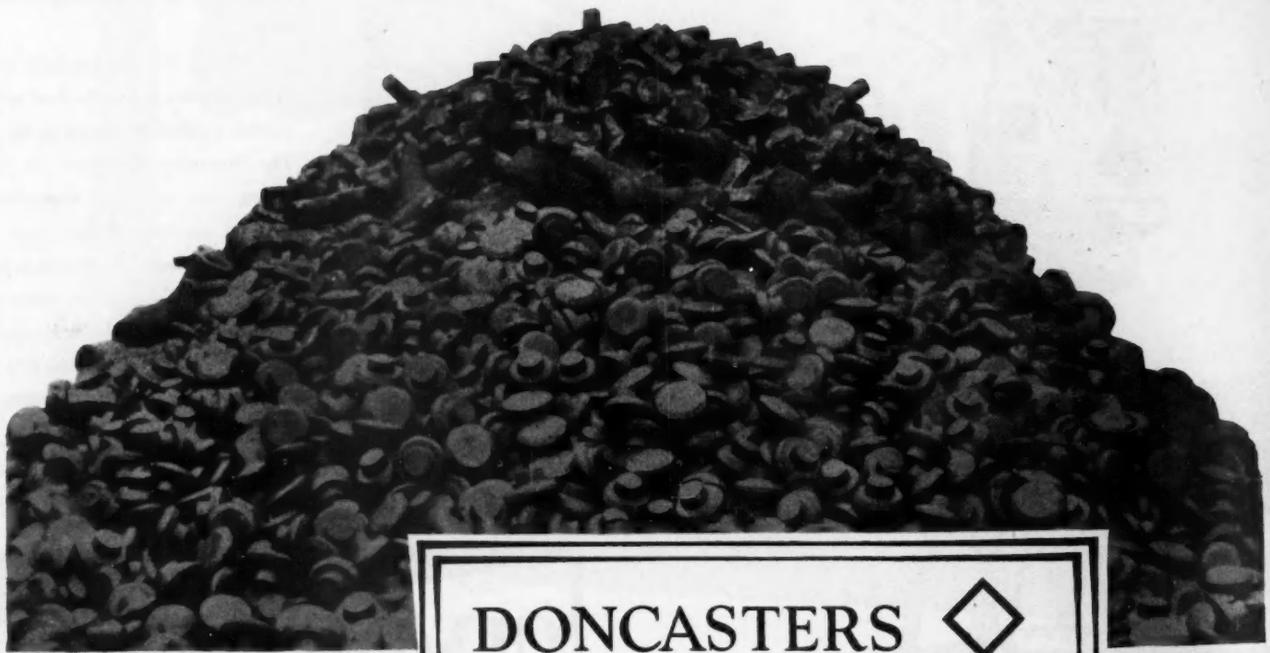

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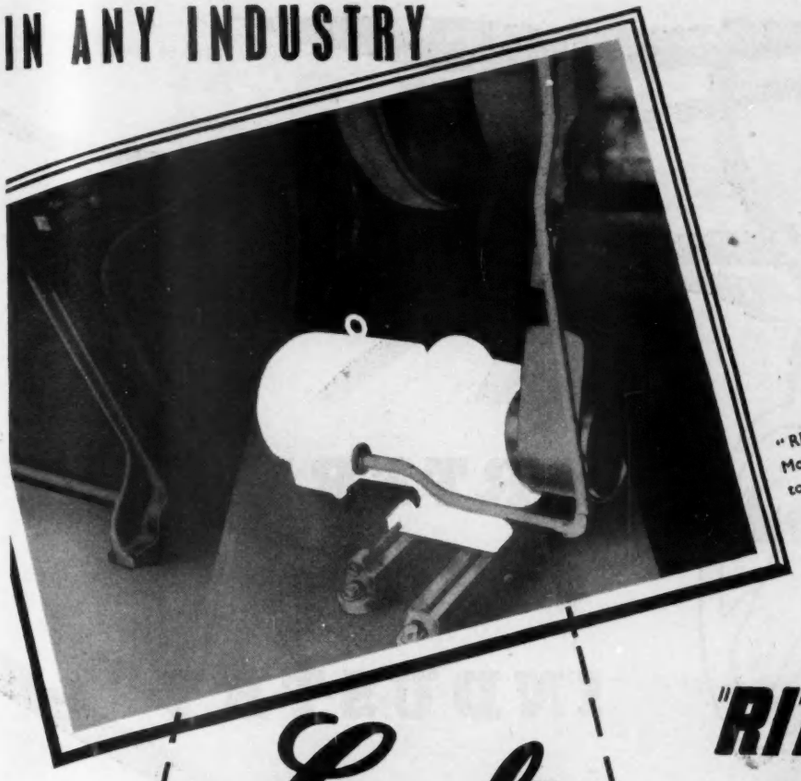

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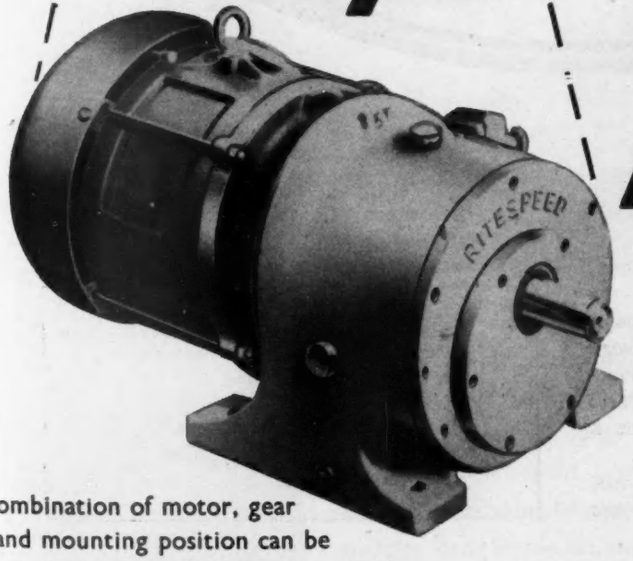

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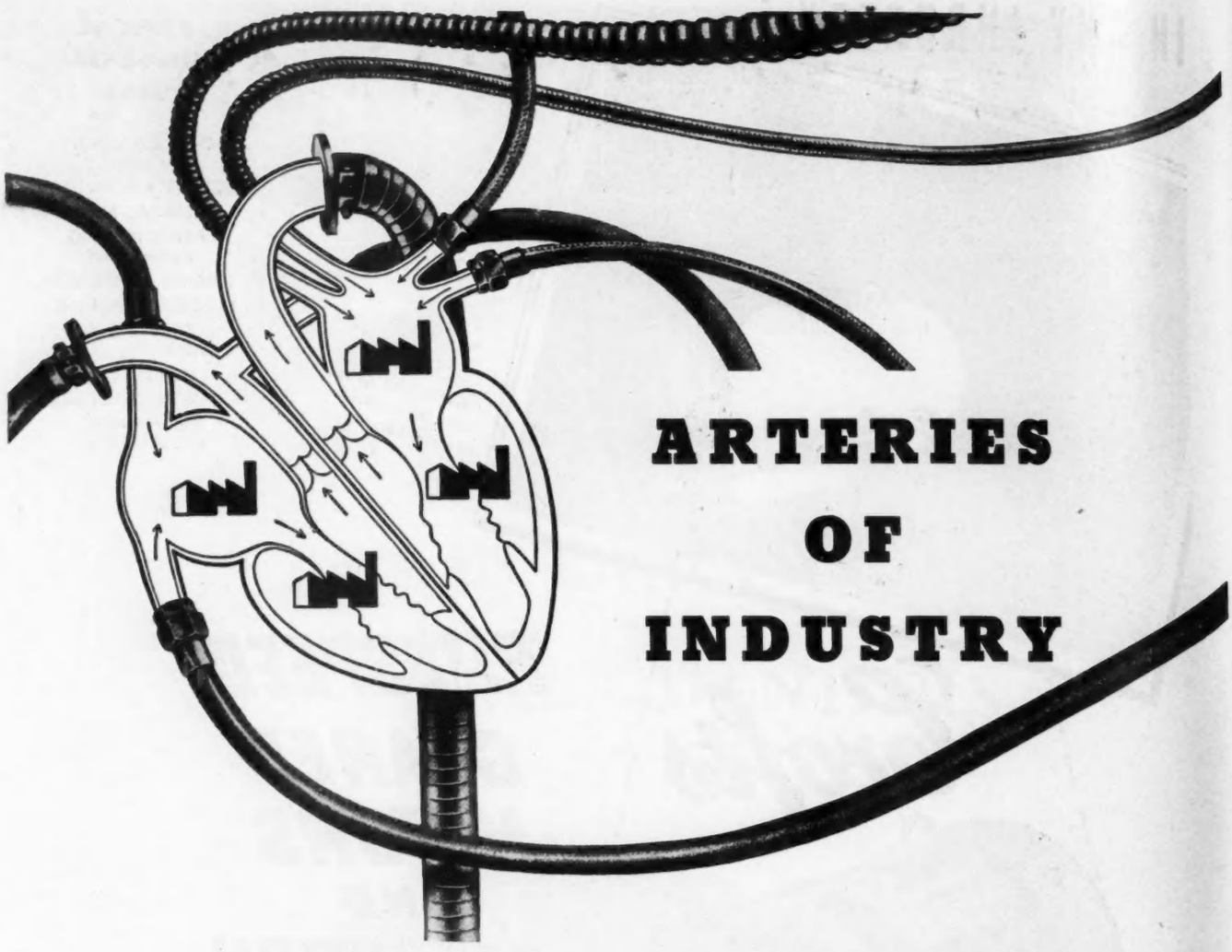

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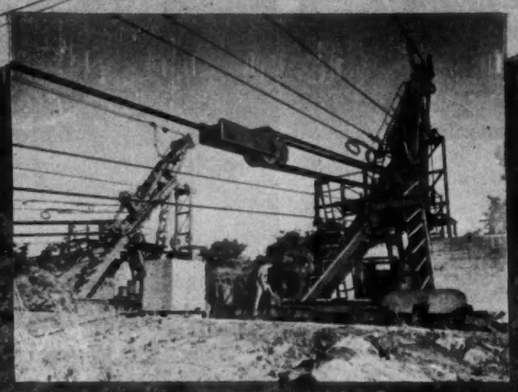

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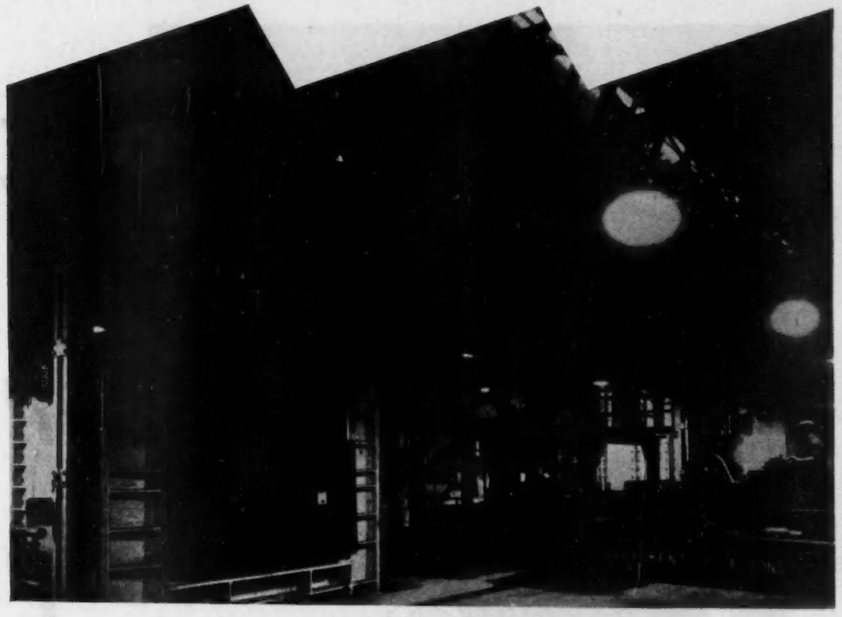

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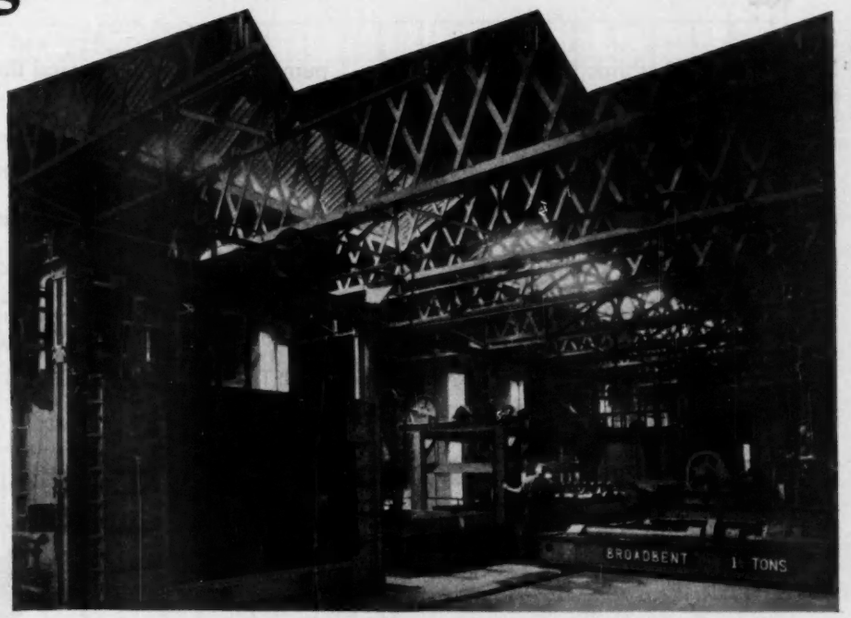

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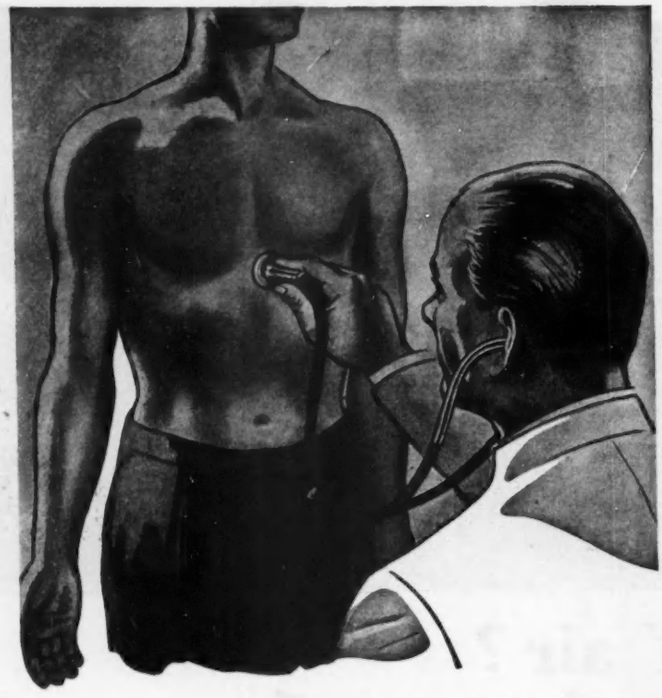

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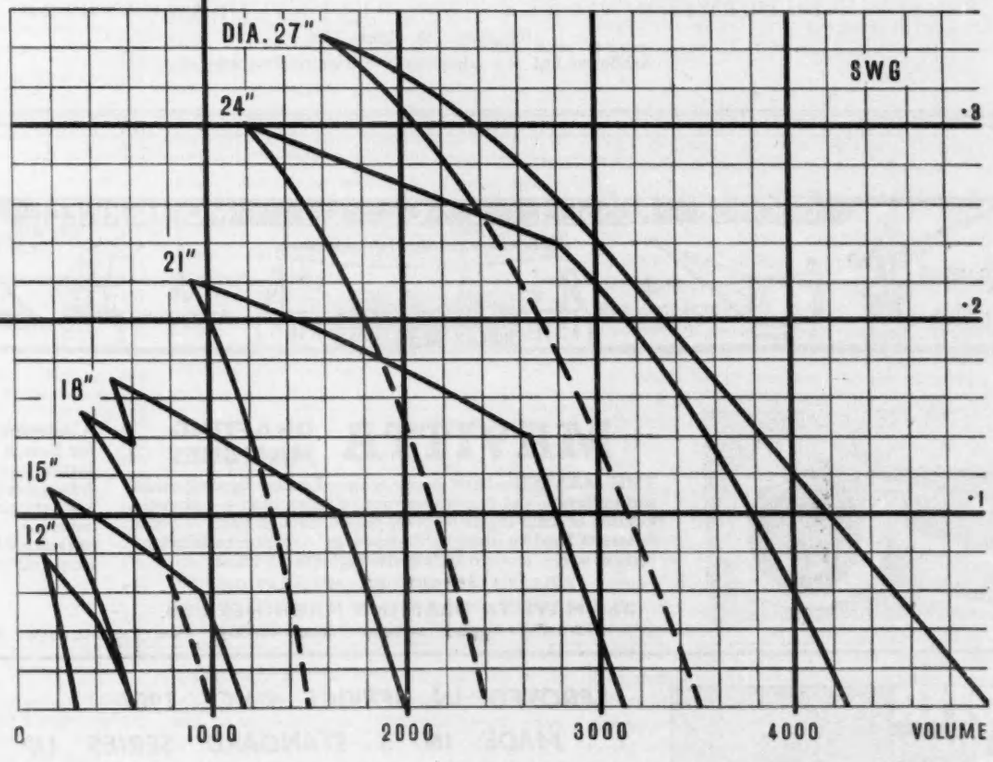

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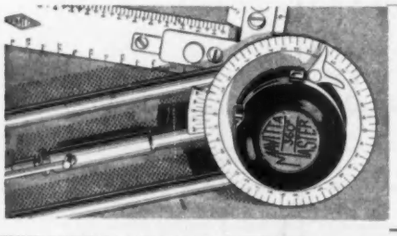

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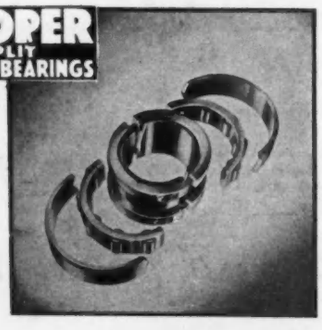

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ENGINEERING

An Illustrated Weekly Journal

Vol. 181 No. 4700 APRIL 6, 1956

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We regret that, as a result of the dispute in the London printing trade, ENGINEERING has not appeared since February 17. With the return to publishing we offer a rebate of 12*s.* on normal subscriptions. Application for the rebate should be addressed to the Manager.

NEW TOWNS IN OLD ENGLAND

IN one of his books Chesterton gave away an idea for a story about a man who set out on a long journey by sea to find New South Wales. After months of voyaging and coming very near to being ship-wrecked he sighted land. When he set foot on the shore he was prepared to be met by cannibals, but imagine his joy and relief when he found it was not New South Wales but dear Old South Wales!

Perhaps some of the thousands of tourists and business men who come from overseas every year to visit England, Wales, Scotland or Northern Ireland will be as surprised as Chesterton's traveller when they discover for themselves not only Stratford-on-Avon and Birmingham, Chester and Liverpool, Cambridge and London, but also Crawley, Harlow and Hemel Hempstead. For these are the New Towns, where the old country has planned anew since the war. They are new towns for industry and new towns for the people who live in them. They show how it is possible for an old industrialised country to overcome hardening of the arteries. If there is no room for expansion in existing towns, if the industrial legacy of a century or more is inflexible—then the solution is to start from scratch out in the country. An article in this issue describes the growth of the New Towns. The author of this article, and we ourselves, are grateful to the corporations and to the many engineering firms who supplied information.

★ ★ ★

MOST business men, if told that forecasting was inherent in their work, would probably express as much surprise as the Molière character when told that he wrote prose. The old-fashioned business man gave his opinion (based on a lifetime of experience) and left little room for doubt, from his tone of voice, that there could be none better qualified for numbering among the prophets.

The emphasis in forecasting should be on sales, because unless a business does this it will be hamstrung in so many different ways. It may take three years to build a new factory, and the country is sprinkled with factories which have been planned too small or too big. Efficient purchasing and stock control depend on sales forecasting. Budgetary control is impossible without it. P.E.P. (Political and Economic Planning) have thus done a useful job in producing a broadsheet, "Business Forecasting."

Many perfectionists feel that since accurate forecasting is impossible it is better not to do it at all—that only a fool sticks his neck out. In fact, sales forecasting can be done with accuracy if it is based on careful market research and analysis of consumption, provided it can be assumed that there are no major changes in outside influences. The errors mostly come from such changes, and to keep an eye on them is one of the main duties of top management and the board.

To be of real value forecasts must be made regularly and kept up to date. It will be found that if they are, their standard of reliability will constantly improve. They will tend to become more detailed and of more practical value to executives lower down the line. For example, a sales forecast for the whole country must take into account regional differences but may not at first give a breakdown by regions. Later, such a breakdown is likely to be asked for and will be of value in assessing market potential, sales force coverage and standards of performance—all of them, perhaps, beyond the original purpose of the forecast.

★ ★ ★

THE decision of the British Transport Commission (subject to the approval of the Minister of Transport) to employ the high-voltage single-phase 50 cycle system for main-line railway electrification marks an important change in policy. It is, at least in part, due to the successful experiments carried out on the French Railways, first on a branch line with steep gradients carrying little traffic, and then on an important main line where heavy freight trains are numerous. These trials showed most impressively the capability of the system to handle all classes of traffic, as well as the economies it can offer. Initially the suitability of the alternating-current commutator traction motor, using an industrial frequency, was called in question, but this difficulty is to be circumvented by employing direct-current motors supplied through either a rectifier or a motor-generator on the locomotive. Experiments in this country on the Lancaster-Morecambe-Heysham line have confirmed that this arrangement is entirely satisfactory when either mercury-arc or germanium rectifiers are used.

As will be seen from the report we give in this issue, the main line from London to Manchester and Liverpool, about 220 miles long, was surveyed to obtain the comparative costs of electrifying it on either the 25kV, 50 cycle or 1,500 volt direct-current system. It is estimated that there would be a capital saving of £5·8 million by using the former, mainly owing to the lower cost of supplying power and erecting the overhead system. Annual costs would also be lower—£11·6 million against £12·6 million. The total

savings for the 820 route miles which are to be electrified will therefore be considerable. This bold programme of work will be a great incentive to the engineers of British Railways and a wonderful outlet on the home market for the contracting firms.

* * *

Plain Words

This is a critical column. It is meant to be. It is introduced in the regular pattern of the journal as a place where critical but constructive comment will invariably be found.

There are several national institutions which are favourite butts for ridicule by the Press. Radio and television, for example, are second only to the Government of the day. The B.B.C. has had more than its fair share. In his autobiography Lord Reith recalls one particularly determined attack on the Corporation which took place in 1934. It was led by some of the most widely circulated newspapers, but the B.B.C. was defended by " the more responsible journals." These journals said that the sensational Press required stunts—a stunt a day if possible. " Whatever the stunt might be, it was extremely urgent and exciting one day, dropped the next. There must, therefore, be an iron ration standby in the incompetence and tyranny of some public institution .... The B.B.C. was the most convenient of all standbys."

Lest we fall into the error of making our own collection of standbys for this column, we begin by criticising ourselves.

For six weeks ENGINEERING has not been published. When so much is happening in the engineering world it is the duty of a technical journal to keep pace with the latest developments; to report, explain and comment in a style that suits the readers. It is not sufficient to suggest that with so many specialised journals circulating, readers welcome a respite. Ideas, inventions, developments and the like are the life-blood of engineering and they must be reported.

The break in publishing was due to a wage dispute in the printing industry. As we are publishers, not printers, we were not a party to the dispute and we had no control over it. In common with the majority of publishers similarly placed, we decided that it was better to stop publication completely, rather than produce a much-reduced issue.

Many events and innovations in engineering are of interest to only a small proportion of readers. There is far too much happening to-day for the individual reader's mental capacity. This is a factor which a journal such as ENGINEERING should take into account, week by week and in its general editorial policy. However, with the return to normal publication this issue represents a further phase in modifying the journal so that more and more of its contents will be significant. We shall, of course, continue to publish contributed articles on important research and development work.)

So much for plain words about ourselves. It can be someone else's turn next week.

A factory at Crawley, Sussex, which is typical of industrial building in the New Towns.

AN ACT OF FAITH

ENGINEERING FIRMS HAVE LED MOVE TO NEW TOWNS

Since the passing of the New Towns Act in 1946, over £130 million has been invested by their corporations in the fourteen New Towns which were established in accordance with its provisions. Eight of these are in the group which was intended to draw off the population from the Greater London area, while the others include Corby, which had previously been almost the company town of Stewart and Lloyds, East Kilbride and Glenrothes in Scotland, Peterlee and Aycliffe built on the coalfields of Durham to provide housing and new forms of employment, and Cwmbran in Monmouthshire.

The greatest progress has taken place in the three towns of Crawley, Harlow and Hemel Hempstead. According to the journal *Town and Country Planning*, for the period ended December 31, 1955, the number of new factories and extensions built in each of these towns and the floor space provided at that date were: Crawley: 45 and 1,533,526 square feet; Harlow: 58 and 1,228,468 square feet; Hemel Hempstead: 29 and 897,050 square feet. The total number of factories completed in all the New Towns was 208 and 5 extensions, providing approximately 6,800,000 square feet of floor space and employing over 37,000 workers. At that date there were under construction 63 more factories and 8 extensions with an estimated floor space of two million square feet. Some of these factories, especially the smaller, standard ones, have been built by the corporations and leased to manufacturers, but a number of the larger ones have been designed and financed by the manufacturers themselves. The industrial estates vary considerably in amenities and appearances; that at Crawley, where some of the finest industrial architecture is to be seen and where considerable attention has been given to the layout, is outstanding.

ENGINEERING EXPANSION

In view of the rapid expansion which has been taking place in the engineering industries nationally and the needs of defence, it is not surprising that engineering plays a predominant part in the industrial life of the New Towns. With very few exceptions the class of work done is light or medium-light and the proportion of skilled workers employed is high, most firms employing more than half skilled workers and many of them more than three-quarters. There was some anxiety at first among the New Town Corporations because it was thought that the proportion of firms producing defence equipment might be dangerous to the future economic prosperity of the towns. In the early days Board of Trade location certificates and building licences were granted more easily to such firms, but the corporations have been making efforts to correct this bias and the distribution of engineering products being manufactured to-day is very wide, covering such diverse products as food and chemical plant, hydraulic drives, ball bearings, electronic and radio apparatus, electric wire, electric generators, electrical controls, scientific instruments and photographic apparatus, materials handling equipment, machine tools, vacuum pumps, aircraft components, razors, liquid pumps, calculating machines and general engineering. A number of small toolmakers and pattern-makers have removed themselves from inadequate premises in London and several large companies have established small branch factories for the manufacture of components, jigs and tools and for experimental work. Some of these branch factories are not strictly in line with the general purposes of the New Towns Act, which was intended to assist in the reduction of overcrowding in London by bringing out complete new factories with their workers. The establishment of completely new undertakings or new branches of existing firms has, to some extent, interfered with this object.

The predominance of engineering firms employing skilled labour, coupled with the absence o commercial and service activities, has meant that there are insufficient opportunities for the employment of clerical workers and women, although the usual complaints are heard about the difficulties of obtaining skilled secretarial assistance. No doubt this situation will change as the town centres and commercial areas are built up; the Corporations are, indeed, trying to bring in more firms producing consumer goods and services. The majority of factories are small, although the distribution of size is probably not very different from the national average for factories employing more than ten persons. There are a small number of factories employing over a thousand workers, but the overwhelming majority employ less than 250. The most popular size appears to be between 100 and 250.

The experiences of firms naturally vary according to their original location, the care with which they prepared their move, particularly in selling it to their employees, and the time when the move took place. The pioneers, who established themselves in the hectic early days,

naturally suffered many discomforts and dislocations which have now been overcome. When the first factories moved in, they sometimes found that such services as water, electricity and telephone were not ready for them. One of the complaints which is still made in some of the towns, for instance Hemel Hempstead and Harlow, is of the inadequacy of the rail services from London. This is not only important for those who wish to return occasionally to the delights of the Metropolis, but also because it makes it difficult to bring out visitors from other parts of the country or from abroad. In view of the substantial export business done by many of the firms this is a serious inconvenience. Harlow has established a Heliport, but there is, as yet, no regular air service.

SKILLED LABOUR

By far the greatest difficulty experienced by all firms in the New Towns, which they share with industry generally, is the shortage of skilled workers. The proportion of employees who are willing to transfer with their employers varies considerably and a heavy responsibility rests on employers to make sure of the suitability of their employees before persuading them to move. Many firms go to a good deal of trouble to ascertain the views of their employees before deciding to move and in selling the idea to them after the decision has been taken. In this the corporations themselves play a considerable part, by sending speakers to address employees and by laying on coach visits to the towns and inspections of the houses. As a result, in many cases 80 to 90 per cent. of employees have made the move, although if only a part of a factory is being hived off an old established plant where the majority of workers are reasonably housed the number is very much lower.

Where a completely new unit is being established, the attraction of a house is a powerful incentive that can be used for building up a labour force, although there is some indication that this incentive is becoming weaker as the housing shortage diminishes. It is, however, impossible to engage fresh labour unless housing accommodation can be offered. It is natural that the enterprising firms who have gone to the New Towns should be those with potentialities for business expansion; in fact that is one of the reasons for their moving, but little provision has so far been made by the corporations to deal with the housing requirements of growing firms. In fact, the housing programmes of most of the corporations are lagging behind the industrial growth, and even firms moving in for the first time find that all their workers cannot at first be housed and they have to provide transport to bring them from their previous homes for several months.

Locations of the New Towns in England and Scotland.

ATTRACTION OF HOUSING

The shortage of houses causes particular difficulty in replacing labour wastage, whether normal or, as is frequently the case in the New Towns, abnormal. Abnormal wastage arises out of the intense competition for the restricted pool of skilled labour and from the fact that some employees accept jobs solely to obtain houses, and then leave and go to work outside the towns. The corporations do make inquiries at the beginning of the year in order to ascertain the housing requirements of their industrial tenants and some of them provide, in theory, a quota of houses to deal with wastage; but, while the overall housing programmes lag behind, these are quite inadequate. Some employers have tried to get the corporations to tie their housing tenants to the employment by virtue of which they obtained their houses, but the corporations have understandably refused to do this.

In order to keep the turnover of labour under control the employers' associations which have been formed in the New Towns have tried to operate informal agreements among their members not to take each other's workers. This has naturally caused resentment among the local trade unions, who feel that it would severely restrict their members' choice of employment, but in any case, in the towns north of London, particularly Hemel Hempstead and Stevenage, it has been rendered nugatory by the recruitment programmes of the motor companies of Luton and Dunstable. The earnings possible in the motor industry are substantially above those possible in the capital goods industries to which the New Town firms mostly belong, with the result that men are willing to travel considerable distances to work in it and frequently do so at jobs requiring considerably less than the skill of which they are capable. A case has even been reported of a skilled moulder going to work as a labourer and earning more at it.

Some New Town employers are particularly bitter that this large expansion should have been allowed to take place so near the New Towns and apparently in contradiction to New Town policy. No plans appear to have been made to build houses for the increased labour force that it will involve, although an eventual increase of 19,000 in the number of workers in the two towns has been mentioned. The bitterness that this has caused is similar to that felt by shipbuilding and heavy engineering employers in Scotland and on the North East coast who have been losing workers to the motor car industry in the Midlands and who also blame the industry's expansion plans for the present shortage of steel and extended delivery time for machine tools. How long this situation will last, in view of the market difficulties now appearing for the motor industry, it is difficult to say. The building of the new airport at Gatwick will, it is feared, draw off building workers from Crawley and increase the lag in the house building programme there.

Terrace houses in a rural setting at Harlow.

WAGES AND OVERHEADS

Wages and overhead costs are considerably higher than in London. The pressure on wages arises out of the fact that rents are rising because of the growing cost of building and higher interest charges and because the majority of employees have young families and are paying off hire-purchase charges on new furniture and television sets—the latter almost essential where amusements are still limited. Increased overheads are sometimes the result of higher charges for transport of goods (although few complain of the actual services provided) and in every case of higher telephone charges, although these are to be expected where firms have previously been used to conducting a large part of their business within the London area. The corporations themselves are generally considered to have been as helpful as they could be and their relations with the manufacturers' associations have been

good. A useful feature of New Town industrial life, where factories are grouped together in one area, is the co-operation that this makes possible between them, although actual provision of communal activities such as industrial medical services or joint apprentice training schemes does not seem to have taken place, except at Harlow, where an industrial medical service has recently been started with financial support from the Nuffield Trust.

If one asks whether the inhabitants of the New Towns are satisfied, it is difficult to arrive at a complete answer. Most employers think that their workers are very pleased with the change and very few have left the towns; but the high cost of living and lack of amenities of a large town cause a certain amount of grumbling, especially among the wives. No doubt this will change as the towns are built up; already a local pride is being generated and a great variety of voluntary social activities is available. Cinemas are gradually being provided, schools being built (although the absence of facilities for technical education will be a serious handicap to progressive firms) and the chain stores will soon be making the place seem like home. A frequent complaint is the lack of internal bus services, but presumably this will be dealt with as roads are built and neighbourhoods are developed.

In spite of all the difficulties the undoubted answer of those firms who have made the move to the question of whether on balance it was worth it is: Yes. Against the difficulties there are the advantages of new and more spacious factory layouts, with room for expansion, and of healthier conditions and a great reduction of travelling time for their workers. It would appear, therefore, that most firms have been able to offset, by increased productivity, their increased costs. Some of them, however, take a broader view of the whole idea. For them the decision to move was an act of faith and the move itself had something of an adventurous quality about it. It was no doubt this feeling, as well as the opportunities it gave them to put new production ideas into practice, which was responsible for the almost universal willingness of senior staff to make the move. In the end, as many have recognised, the New Town policy will not be judged in economic terms alone, but in terms of the wider social benefits that it will bring to those who live and work in the towns it is creating.

Letters to the Editor

TESTING CONCRETE QUICKLY

Limitations of the Steam Bath

SIR, I was very interested in the article by Mr. T. N. W. Akroyd and Mr. R. G. Smith-Gander on page 153 in your issue of February 17.

In the *Chartered Civil Engineer* of November, 1955, I indicated quite clearly that I did not consider my curing regime was the only suitable one, and I have in fact advised a number of engineers who were cut off from electric power to heat in a container constructed on the lines of the old fashioned steamer, where the cubes are in a dry chamber but almost completely surrounded by a steam jacket. I think this preferable to direct water immersion, as the cubes are easier to handle and less liable to have their water-cement ratio altered, and the moulds are less likely to corrode. I am pleased to see that my advice was probably sound.

My own objection to the steam bath, or direct boiling, is based on several practical considerations. In the first place, I wish to be able to leave the apparatus unattended for as long as is desired, and to have it start and stop on its own during the night. I am not in agreement with the authors' statement that the strength of the concrete does not increase after seven hours of heat curing. In the oven at least cubes are still gaining strength after 24 hours, though by that time the rate has slowed. It is possible that different time regimes may give more accurate strength predictions for 7 and 28 day values, and that scatter with different cements may be less. These points are at present under investigation and make automatic control almost a necessity, unless one works 24 hours every day. Hence for laboratory work, as distinct from site work to the nearest 10 per cent., I prefer to have electrical control, and to be without fear of the pot boiling dry in my absence.

Additionally, I am averse to having large amounts of steam in a concrete laboratory. Out of doors on a site, this does not matter.

On the qusetion of delay before curing, I found 18 hours delay followed by 4 hours heating gave about the same strength as 6 hours heating. Delay therefore is significant if it amounts to hours. Delay after curing was only tested with cubes still in the oven, which was switched off automatically during the night, and allowed to cool. A strength increase of 40 per cent. was recorded for 17 hours delay, of which 8 hours was at a temperature not very much above room temperature.

Curing at a temperature above about 90 deg. C. in the oven caused a definite strength decrease. This may have been due to drying, in spite of cover plates, but such an explanation is not considered likely as other cubes which were known to have been liable to drying actually showed increased accelerated strengths. These latter were of a wet mix.

My own tests indicate that super-sulphate cement can be tested in this way, but that aluminous cement is not likely to be amenable. They also indicate that Crown cement fits in with other Portland cements when oven cured, but not when cured on a dielectric heater. The authors' boiling tests indicate a great departure from the writer's Blue Circle figures. Since cements vary widely in their peculiarities I fear that, on the evidence produced, the boiling test is unlikely to be as reliable as the oven test as long as there is any risk of cement variation. I am at present investigating the behaviour of cements specially selected to cover the full range of peculiarities liable to be met with commercially. In no case does the range of the 7 and 28 day strength variation for a given accelerated strength amount to over 1,000 lb. per square inch, even though I am using cements selected as being those most likely to throw the test wrong. The range of strengths found with the boiling test is about 2,000 lb. per square inch, which compares very unfavourably with the oven tests, particularly when obtained with only three samples.

In conclusion I would congratulate the authors on their enterprise, and would urge them now to do their best, by further tests on varying cements and aggregates, to determine the full range of error that their method is likely to give. If they can convince me it is better than oven curing, I shall be pleased to drop my method forthwith. In the meantime I prefer the additional reliability I am getting by using slightly more expensive equipment, and will still recommend it for site use where conditions permit.

I should be grateful if Messrs. Akroyd and Smith-Gander would advise me of any future discoveries, as my one desire is to see that the cheapest and most reliable test is established.

Yours faithfully,
J. W. H. KING,
Professor of Civil Engineering.

Queen Mary College,
London, E.1.
March 19, 1956.

★ ★ ★

LONDON MEMORIAL TO FARADAY

SIR, I must contravert the statement in your issue of February 17, page 146, that there is no memorial to Michael Faraday in London. The Royal Society of Arts erected a plaque in 1876 on the house, 48 Blandford-street, W.1, where Faraday was apprenticed in 1805 to George Riban, bookbinder and bookseller.

This is certainly far from an adequate memorial to the greatest experimental physicist of the Nineteenth Century, but I could not let your categorical statement go unchallenged.

Yours faithfully,
T. [illegible] WATKINS.

12a, Myddelton-square,
London, E.C.1.

[*Editor's Note.*—A meeting, with Lord Citrine in the chair, was held on March 21 to consider proposals for a permanent memorial in Southwark to Faraday. Several possibilities were suggested including those of a statue, a plaque near to Faraday's birthplace, and the founding of two scholarships—one in chemistry, the other in electrical engineering. A committee was formed to consider "the nature of the memorial and the cost thereof" and comprises, apart from local dignitaries, Mr. W. K. Brasher, C.B.E., secretary of the Institution of Electrical Engineers, representatives of the Faraday Society, the Royal Institution and the Central Electricity Authority, and Miss Vera Norvick of the Electrical Association for Women.]

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ORIGIN OF THE SANDWICH SYSTEM

SIR, In the Government White Paper on Technical Education there appears a statement about the introduction of the "sandwich system" in engineering education which in the interests of historical accuracy calls for correction. The allusion to the 1880's is misleading. The sandwich system, whatever its merits, started long before that, and it did so in the University of Glasgow. Since the establishment of the University's school of engineering in 1840, the teaching session has been of two terms, leaving half the year free to the student for his professional practice.

No other school fully adopted the six-months' session until comparatively recent years.

Yours faithfully,
W. LAWRIE TAYLOR,
Lecturer in Mechanical Engineering.

Department of Mechanical Engineering,
The University,
Glasgow, W.2.

★ ★ ★

THE ROYAL SOCIETY

Annual Election of Fellows

At a recent meeting the Royal Society elected into the Fellowship 25 scientists, including: Dr. NORMAN PERCY ALLEN, superintendent, Metallurgy Division, National Physical Laboratory, for his work on alloy steels, their transformations and their engineering properties. PROFESSOR JOHN FLEETWOOD BAKER, O.B.E., Professor of Mechanical Sciences, University of Cambridge, for his experimental and theoretical investigations of steel structures and for services to education in engineering. PROFESSOR RICHARD MALING BARRER, Professor of Chemistry, Imperial College of Science and Technology, London, for his work on the mechanism of adsorption and diffusion of gases in solids. PROFESSOR JOHN ALFRED VALENTINE BUTLER, Professor of Physical Chemistry, University of London, for his work on thermodynamics and various branches of physical chemistry. MR. DENNIS GABOR, Mullard reader in electronics, Imperial College of Science and Technology, London, for his work on transient electric phenomena, electron microscopy, the theory of communication and the electric-arc plasma. PROFESSOR NICHOLAS KEMMER, Tait Professor of Natural Philosophy, University of Edinburgh, for his pioneering work on the fundamental particles of physics, particularly on the meson. MR. NICHOLAS KURTI, lecturer and demonstrator in physics, University of Oxford, and senior Research Fellow, Brasenose College, for his work on phenomena at very low temperatures. MR. JOHN WESLEY MITCHELL, reader in physics, University of Bristol, for his work on the action of light on crystals. MR. ALFRED BRIAN PIPPARD, lecturer in physics, University of Cambridge, for his work on the electrical properties of metals at radio frequencies and for his studies of the superconducting state. MR. MAURICE VINCENT WILKES, director, University Mathematical Laboratory, Cambridge, for his contribution to the design, construction and application of automatic calculating machines. MR. DENYS HAIGH WILKINSON, lecturer in physics, University of Cambridge, for his researches in nuclear physics, especially his investigation of the properties of the energy levels of light nuclei.

Weekly Survey

Cover Picture. *Assembling the commutator of an electrical machine: copper strips interleaved with mica.*

* * *

U.S. Company Seeks Ideas in Europe

Practical evidence of the high respect paid by American industrialists to the quality of basic research carried out in Europe has been provided by the American General Electric Company. The G.E. Research Laboratory, Schenectady, N.Y., have set up an overseas office in Zurich "to strengthen scientific contacts" of the company with the basic research activities in Western Europe. The head of the new office, Dr. George J. Szasz, will spend much of his time attending scientific meetings and visiting laboratories which conduct fundamental research in spheres of G.E.'s activities.

American interest in European research was doubtless titivated by the major contribution made by European scientists to defence projects undertaken in the U.S. during and immediately after the war. Traditionally, however, Europe has been the experimental workshop of the world, and the most prolific source of new ideas and prototypes. The Americans have excelled at transforming them into commercial products and selling them to the world. Increasingly in recent years, mainly because the world lacks U.S. dollars, they have sold manufacturing licences to European industry or come over to set up manufacturing facilities themselves.

The amount of research and development undertaken by private industry in the U.S. is immense. The latest survey, carried out by the U.S. National Science Foundation, showed that, in 1953, 3,700 million dollars were spent by private industry (out of a total of over 5,000 million dollars spent by the nation as a whole) but only 4 per cent., or 150 million dollars, were spent on basic research. Were such figures available in this country, or in Switzerland, France or Germany, they would most probably be found to be reversed. It is questionable, however, how long European industry should remain in this role and allow the most valuable fruits of its basic research to flow freely across the Atlantic. G.E. are to be congratulated on their enterprise, strictly from their own point of view.

* * *

Engineering Scholarships for Northern Ireland

In connection with their £8 million extension project at Larne in Northern Ireland, the British Thomson-Houston Company announce that in association with the Faculty of Applied Science and Technology of Queen's University, Belfast, they have introduced an industrial scholarship plan for boys who are normally resident in Northern Ireland, covering both academic and practical training in electrical and mechanical engineering.

The scholarships, of which two or more may be offered each year, cover a period of five years, including three years to be spent full time at the University. Boys will spend the first year as pre-university student-apprentices at the Rugby works of the company, when a maintenance grant will be paid. The next three years will be spent at college, with vacation periods in the company's works, and during this period a scholarship grant of £300 per annum will be paid, thus enabling the student to meet all fees and other expenses while at college. The final year is to be spent at the Larne Works, when a graduate apprentice wage (at present £450 per annum) will be paid.

Though it has been a common practice for industrial companies to send the best of their young men to university for academic training, this is one of the first schemes to be announced where companies have entered into a specific association with a university department to provide an overall training for candidates selected by the company.

Further details of the project may be obtained from the company at Rugby.

* * *

Workers Can Acquire Skills More Quickly

What can be done to reduce the time required by a new man or woman to become proficient in a repetitive factory job? If the time could be halved there would be a substantial saving, especially when labour is scarce.

An improvement of this order, or better, has been achieved in several industries since the war. Mr. W. Douglas Seymour, of the Department of Engineering Production at Birmingham University, recently described the basic principles. Addressing a conference in the Midlands, organised by the British Institute of Management, he showed how operator skills can be imparted to new workers to such good effect that sometimes they become quicker and more adept than men or women who have been on the job for years. First, the skill of an experienced worker is analysed. This analysis shows whether the use of preliminary training exercises or devices will be helpful. The task is then divided into several parts suitable for training purposes, special attention being paid to those parts which involve the use of the senses coupled with decisions based on sensory information. The trainees practise the preliminary exercises, then practise sections of the job, then the whole of the job, then repeat the cycle several times—and so on until an eight-hour day can be worked efficiently.

That is a bare outline of the method. It has been applied successfully by several large firms. It leads to savings in direct labour costs varying from a few pounds to nearly £50 per trainee; to a reduction in overheads of as much as £100 per trainee; sometimes to substantial improvement in quality and to savings in material; and to a reduction in labour turnover. As Mr. Seymour said, the men and women begin to understand what is under their noses; it is a method of developing human personality which has hardly been tapped.

* * *

The Four M's

Men, materials, machines and money—those are the resources of a firm which are commonly in short supply. Ways of determining the most profitable use of them were suggested by Mr. J. H. Whicheloe, chief cost accountant of Henry Hope and Son, Limited, makers of metal windows, at the B.I.M. conference mentioned above.

Considering any of the four resources, the first principle, he said, was to establish an appropriate standard and "check the effectiveness of your actions against the standard." A standard of training should be determined for every grade of employee and the effectiveness of the training should be checked by a passing-out test. A detailed and scientific study of the work of direct operatives could be made so that direct incentives could be applied. For indirect workers an index of performance based on the average experience of some past period was usually employed.

Scrap material, Mr. Whicheloe said, was usually considered in two categories—"avoidable and unavoidable." But even the latter category could be reduced. Expensive materials might be replaced by others less expensive. Some components were unnecessarily strong. By modifying a design the waste arising from the manufacture of one component could be avoided or it could become the blank for another component.

Referring to the third resource—machines—Mr. Whicheloe said that "to express idle facilities in terms of cost or lost profits is far more potent than the current vogue of expressing machine utilisation as a percentage of maximum." His remarks on money included a practical system to deal automatically with the problem of keeping debtors down to a reasonable level.

* * *

Automation is Practicable

The specially designed transfer machine is often not sufficiently flexible to be worth while. But the advantages of automation may still be reaped in either of two ways: by means of unit heads arranged in the most appropriate manner to suit the product; or by grouping standard machines and linking them together with known and developed linkages. This recommendation was made at the B.I.M. conference in a paper by Mr. D. A. Oliver, director of research to the B.S.A. Group, and Mr. C. A. Judson, research manager of the Group's engine and mechanism laboratory.

It is more enlightening, they suggested, to examine the door-to-door time of material than the floor-to-floor time, since the former concept reveals the indirect costs such as handling costs and capital wastefully invested in work in progress. Thus the most profitable aspect of automation in normal production factories is the handling of materials. In Great Britain, the authors pointed out, automation is likely to be a progressive development not universally applicable but powerful when finance and manpower of the right kind can be brought together. The biggest step forward would be the automatic assembling of individual components into a composite whole. It would probably introduce completely new conceptions of design—perhaps package assemblies cheap to make but not worth stripping for servicing.

* * *

Spring Thaw for Cars

An early Easter this year has helped car manufacturers to move the large build-up in car stocks. Some weeks ago, when overtime was cut and certain motor-vehicle factories put on short time in the middle of the cold spell, stocks had reached about 80,000 cars. Sir William Rootes has since said that sales are improving, and Vauxhall Motors have reported that car sales have been running at a higher level than at the same period of 1955. Standard Motors have also reported an improvement and there has been a significant hardening of used car prices. Nevertheless some companies were glad to take the opportunity of closing their plants for a somewhat longer Easter break than usual.

It is too soon yet to say how strong the seasonal recovery in sales is going to be. The various aspects of the credit squeeze at the moment still look like having a depressing effect on the volume of car production through the restrictions imposed on home sales. It is a testing time for all car manufacturers. The difficult situation in which they find themselves was underlined by Sir Rowland Smith, retiring chairman of the Ford Motor Company, Limited, in his annual statement. Ford's competitive power at home and abroad is generally considered to be pre-eminent, and they are continuing with their expansion programme in the expectation that the long-term trend of car buying is upwards both at home and abroad. Meanwhile it is clear that the company is being affected by rising costs, which reduced the net profit per vehicle in 1955 from £34 to £30—a decline which has probably continued. Wages and the cost of bought-in materials have been increasing and the acceleration of the modernisation programme has temporarily forced up overheads. It will take a significant expansion in output to counter-balance these increases. Hence the problem of boosting sales at home and abroad as quickly as possible. In this respect Ford are typical of the other big motor vehicle manufacturers. They are temporarily caught between the official credit squeeze which affects sales in the home market (and no company can be expected to increase export sales over-

night) and their decisions last year to press on with major expansion programmes which can be justified only by increased sales.

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Leonardo Knew How

Only 12 per cent. of all full-time students in British universities are reading technology. Yet it is those who are ready to put science to practical use who are required, rather than pure scientists. It has even been said that in this country the ratio of those entering pure science as compared to those taking up the practical side is two to one. It would be of greater benefit to the country as a whole if this ratio were reversed.

With such thoughts in mind, the Institution of Mechanical Engineers have inaugurated a series of lectures for boys with the purpose of interesting them before leaving school in the subjects of applied technology. The general subject for the 1956 lectures is " Energy in the Service of Man." The first, on fundamental energy, is to be given by Professor D. G. Christopherson, of the Imperial College of Science and Technology; the second, on applied energy, will be by Sir Claude Gibb, of C. A. Parsons and Company Limited; and the third, on nuclear energy, by Sir Christopher Hinton, of the Atomic Energy Authority. The series will be known as the Leonardo da Vinci lectures, and this title has been selected because Leonardo was supreme in the application of his ability over the whole field of art, science and technology. Many authorities feel that the tendency towards specialisation in schools should be discouraged, and that the ordinary school curriculum should give boys the widest knowledge of science and the humanities

The Institution hope that this series of lectures, which will take place each year, will interest both boys and masters in the possibilities of applied science. They are intended to be of a very high standard—equivalent to those which have been given for many years by the Royal Institution, but of a more practical nature. All places for the present series have been booked; the demand was so great that a rationing system had to be used.

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American Gas-Turbine Car

While General Motors have been dramatising their gas-turbine research by installing turbines in futuristic dream cars, the Chrysler Corporation deliberately play down the drama by using normal production saloons as research vehicles. Their latest demonstration is a 3,000 mile run with a turbine-powered Plymouth saloon from New York to Los Angeles, passing from the blizzards of a late winter in New York, via the heat of New Mexico and Arizona, to California. Thanks to its regenerator, the car is said to have a fuel consumption of 18 to 20½ m.p.g. at speeds of 30 to 40 m.p.h., and the exhaust is said to be much cooler than that of a piston-engined car. The regenerator is reported to utilise over half the waste heat in the turbine efflux, but no details have been revealed on the methods employed.

Shaft output claimed for the turbine unit is 120 horse-power. With reduction gear it measures 32in. long, 33in. wide and 28in. high, and its weight is quoted as 200 lb. below that of an equivalent piston unit. It idles at 20,000 r.p.m. and the maximum design speed is 50,000 r.p.m. The compressor is a single-stage fully shrouded centrifugal unit, driven by a single-stage turbine; another single-stage turbine, of about 6 in. diameter, provides the power. Blades and wheels appear to be machined from a single forging. Petrol is the fuel used, and current research on regeneration is said to have opened up prospects of eventual thermal efficiencies approaching 40 per cent.

Chrysler began turbine investigations in 1945, and in 1947 designed a turbo-propeller aero-engine with regenerator for the U.S. Navy. Research is now concentrated on noise reduction, improvement of acceleration, production methods, and perhaps most important, the use of low-cost " non-strategic " materials. The car is already reported to be very quiet inside, if the windows are closed to exclude air-intake scream, and this foreshadows a new programme of investigations into road noise, which is now more easily audible.

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Flight from the Airlines

Sir Miles Thomas's decision to leave the British Overseas Airways Corporation robs the British airline services of another major personality in a matter of months. Both Mr. Peter Masefield, who left British European Airways recently to join the Bristol organisation, and now Sir Miles, who is to be chairman of Monsanto Chemicals, Ltd., are colourful personalities who have achieved notable successes and have chosen to go almost in the hour of triumph. Both have had to handle cumbersome organisations and streamline them. Both have had serious technical problems for their staffs to cope with. B.E.A. eventually triumphed with new aircraft, especially the Viscount. B.O.A.C. succeeded despite the initial disappointment with the Comet.

It is conceivable that Mr. Masefield might one day return to airline operational work. The fact remains, however, that a nationalised industry has failed to hold two key, top men even in the process of getting out of the red and recording profits. Both men might say (Sir Miles has indeed said so himself) that they have accomplished their immediate job and feel free to tackle another problem elsewhere. This may well be so, but it is not quite convincing. There is a strong impression that either the rewards or the climate (or both) of nationalised industry are inimical to the best and most forceful type of executive. This is a serious issue and of wider application than the air transport industry. Industries like these, which compete in an international market to some degree, need enterprise, decision and forcefulness at the top. They cannot stay out of the red by cumbersome forms of management by committees. But it is this last that they will get if the Masefields and the Thomases are frightened away.

★ ★ ★

Tractors for China

A remark of the President of the Bank of China at the recent Leipzig Spring Fair has found a quick re-echo in this country. Mr. Man Han-Chen said that China wants to place orders abroad for 1·4 million tractors. In turn, this would mean a replacement rate of about 120,000 a year. He added that once the details of China's agricultural mechanisation scheme have been settled, they will not be easy to change and in consequence British concerns would have to get in at the beginning. This broad hint has got home.

The inaugural speech of the new President of the Agricultural Engineers Association, Limited, given in the middle of last month by Mr. Lionel Harper, managing director of Massey-Harris-Ferguson Limited, made due reference to the Chinese tractors. He pointed out that despite the tremendous expansion in the output and export of agricultural tractors in the United Kingdom, markets were beginning to slow down. He said that each tractor should take at least three implements—which means over 4 million pieces of agricultural machinery. He appealed to the President of the Board of Trade to remove the embargo on tractors to China. He pointed out that Russia has recently set up a gift tractor station in India comprising 72 tractors, 60 combines and over 500 agricultural implements capable of manning a farm of 15,000 acres and that other similar gifts have been made in the Middle and Far East.

This pressure on the Board of Trade comes at an interesting time. The Government is fully aware of a need to sell machinery in the Far East against Russian competition. Nearer home there has been much propaganda of late about the need to switch resources from the home to the export market. What better way of moving products from the home to the export market than the switch to a limited extent from motor cars to tractors? It will be interesting to see if this fortunate conjuncture of circumstances and theory have any effect on the China embargo.

Chrysler Corporation's gas-turbine car.

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David Brown Looks Ahead

Higher turnover with lower profit margins is becoming a fashionable complaint in the engineering industry. The symptoms became general in the motor-vehicle and vehicle-components industries at the turn of the year. The Ford chairman's statement, published last week, confirmed the trend. Now a large and much-diversified engineering group, the David Brown Corporation, Limited, have followed suit. The annual report of the group shows consolidated profits to have declined by 9 per cent. to £1,252,951 in the year ended June 30, 1955, owing to higher wages and material prices. Mr. David Brown, the chairman of the Corporation, points out in the report that had it not been for an increase in turnover of some £2 million, this margin would have been still lower—and, for the future, serious doubts are entertained as to whether the 1954/55 profit margins can be retained without some increase in prices.

The David Brown Corporation, however, while frankly admitting that the future is by no means going to be easy, have taken steps to defeat or modify the expected difficulties. In December, 1955, David Brown Industries Limited was formed to co-ordinate the various plants of the companies throughout the United Kingdom, and Mr. David Brown is confident that " this streamlining of our organisation will prove its value in the competitive times that lie ahead of us." Also in the news last year was the purchase by David Brown interests of the share capital of Harrison, McGregor & Guest, Limited, and this has enabled the Corporation to offer complete " systems " of agricultural machinery, in which a full range of implements may be supplied with the tractor, to their customers.

Among the Corporations' widespread interests, an impressive run of sporting successes is claimed for the Aston Martin DB3S and the production-type DB2-4 cars, while exports of gear-cutting machine tools have been maintained in the face of intense competition from the United States and the Continent. New accommodation and plant has been installed for the production of gearboxes and the new factory at Huddersfield will assist the further increase of output. Meanwhile, the Corporation is to be complimented on sending 60 per cent. of its orders abroad last year.

Steel Takes the Strain

Investment in new steel works in under-developed areas is gathering momentum. In addition to the three new plants in India which have been known for some time, the first strip mill to be built in Malaya will begin operations this month; a small steelworks is also to be constructed in Nepal. On the other side of the world it was announced in February that the Export-Import Bank had sanctioned a 35 million dollar loan for an extension of steelworks at Volta Redonda, Brazil, which will raise capacity from 650,000 tons to 1 million tons a year. Meanwhile, the Bethlehem Steel Corporation of America is reported to be considering the installation of a steel plant in Minas Gerais to be situated between high-grade ore deposits at Itabira and Conceicao de Mato Dentro in Brazil. In India it was recently announced that Stewarts and Lloyds and the Tata Iron and Steel Company would jointly erect a £2¼ million tube works at Jamshedpur. Future developments at Jamshedpur are planned with an intended £1¼ million welding mill and a possible seamless tube plant.

In this country, the rate of domestic investment in steel shows no sign of slackening. Within the last few weeks, John Summers and Sons have ordered rolling-mill equipment to the value of £1¼ million from the Davy and United Engineering Company. The Woodall-Duckham Construction Company are to build a £2 million coke-oven and by-product plant at the Scunthorpe works of Appleby-Frodingham, while Samuel Fox and Company have recently ordered £250,000 worth of electrical equipment from the Metropolitan-Vickers Electrical Company, for two hot reversing rolling mills at Stocksbridge.

The United Kingdom thus continues to sell steel-making machinery both at home and abroad at a rapid rate. The recent decision to advance money for the big Indian steel project at Bhilai shows that rapid orders are being sought even if it means investment of Sterling to get them. Recent events in India and South America suggest that this is likely to be the normal pattern for the future. Expanding home and overseas steel capacity (and finding the machinery and the finance for both) is a severe strain on a country like Britain with a balance of payments problem—but it is a strain that may well have to be endured.

* * *

Freer Trade or Soft Option?

In September, 1955, a Treasury Bulletin for Industry pointed out to British manufacturers the dangers of ignoring a valuable market across the Channel. The warning seems to have been needed for it has been known for some time that inter-European trade has been growing. While liberalisation of European trade is all to the good, there are certain inherent dangers if trade between European countries becomes "a soft option" at the expense of trade with the outside world. The recently published 7th Report of the O.E.E.C. on "Economic Expansion and Problems" carries a warning that this is just what has been happening.

The report points out that one characteristic of this trend during 1955 was that while imports from the dollar area mounted by 40 per cent., imports from other areas outside Europe expanded by only 4 per cent. and exports to the dollar area failed to increase correspondingly. One result of this was that between the second half of 1954 and the first half of 1955, current trade balance of all O.E.E.C. countries with the dollar area fell from a surplus of £250 million to virtually no surplus at all. Meanwhile, although trade between member countries rose by 15 per cent., the expansion of exports to countries outside Europe rose by no more than 6 per cent. In the latter part of 1955, the trend improved somewhat owing to the recovery in the U.S.

Emphasis is put in the report on the need for further efforts to liberalise trade with the rest of the world. Exports to the dollar area are a high priority, for expanding industrial production in Europe involves higher raw material imports from that source. Concern is also expressed about the extent to which dollar receipts are at present dependent, not on trade, but on U.S. military expenditure. Emphasis is put on the need for higher coal, steel and nuclear energy output. Altogether, Western Europe's problems are very similar to those for the United Kingdom alone.

* * *

Firm Prices Again

A plea to the President of the Board of Trade was made last week to obtain the Government's help in securing a return to the practice of quoting firm prices. The deputation came from the National General Export Merchants' Group and the Purchasing Officers' Association They pointed out that although the Government might not be able to influence directly the practices of private companies on their terms of business, it could give an effective lead through its influence with steel and nationalised industries. The President was told that the widespread use of a "prices ruling" clause by British industry was having a serious effect on export business. It was claimed that Continental suppliers now invariably quote firm prices and that a serious loss of goodwill had come about by British industry's failure to follow their example. The deputation said that the restoration of firm-price trading would increase the mobility of labour because many manufacturers would not be able to keep up the cost of maintaining skilled men working short time and it would also strengthen their resistance to irresponsible wage demands.

It is quite clear that the deputation had in mind the recent wage increases in the coal and transport industries. With the recent laudable attempts by many companies undertaking to maintain stable prices for a definite period the feeling has been growing that such a move would achieve quicker results if the nationalised industries could be persuaded to do the same thing, especially as most of them are trading in a protected home market. The visit to the Board of Trade has a faintly ironical flavour, for the Minister of Transport had only a few days before made the remarkable (it may well prove to be notorious) statement, that there would be no large-scale increase in rail charges for six months while the British Transport Commission was carrying out certain changes which would increase the efficiency of the railway system. Rail freight, dock and canal charges would go up by 5 per cent. with passenger fares remaining untouched for the time being. This, presumably, is a move in the direction in which the deputation would have the Government go. It is not a "freezing" of rail charges but it is at least a damping down of an increase for a specified six months period. One hesitates to think, however, of the effect which this type of announcement might have if it were used as a pattern for other nationalised or nationally controlled industries. Is the price of stable charges by nationalised industries to be merely a delayed increase because the industry concerned cannot possibly fulfil undertakings about increased efficiency which Government Ministers make on their behalf?

* * *

New London Television Station

The new London television station of the British Broadcasting Corporation at the Crystal Palace was brought into service on March 28. It replaces the station at Alexandra Palace which began operation in 1936, and will use the same frequencies (vision 45 megacycles and sound 41·5 megacycles) although vestigial upper sideband transmission will be employed for vision. As a result it will be possible to extend the service in Kent, Surrey and Sussex without introducing a corresponding loss in the north and north-east and at the same time to join up with the areas covered by the stations at Sutton Coldfield and Rowridge and, later, Norwich.

To comply with the requirements of the London County Council the station building is sunk beneath the upper terrace of the Palace grounds so that the area above it will remain available to the public. Mechanical ventilation has therefore been installed and a considerable part of the building, including the transmitter hall, relies on artificial light.

The Marconi technical equipment is in general similar to that in use in the Corporation's other television stations. Improvements in design have allowed greater compactness to be obtained and the vision signals, which reach the station over duplicate coaxial cables, are cleared of noise automatically. These cables, which are used for two-way working between the station and Broadcasting House, require no intermediate repeater equipment owing to their low attenuation. The sound programme reaches Crystal Palace over Post Office lines. There are two vision and two sound transmitters, the former having a peak white output power of 15 kW. A pair of high-power tetrodes is included in the final stage, where grid modulation takes place, the arrangement being such that receiving-type valves can be used and the number of radio-frequency amplifying stages reduced. Another interesting feature is the triple tuned output circuit in the final stage. For reliability, metal rectifiers are used for the 6 kV anode supply. The sound transmitters have a rated carrier output of 4½ kW, but will operate at 3¾ kW to preserve the standard ratio of 4 to 1 between peak white vision and sound carrier power.

The outputs of the four transmitters are controlled from a separate room and are combined in two filter units. From these units feeders are led to the base of the aerial tower through a switching room. Normally, the output of each combining unit is connected to one half of the aerial system. At present this system consists of six dipoles mounted in two tiers at three corners of a 250 ft. triangular temporary mast. A 640 ft. permanent tower is under construction and, when completed next year, will carry four stack dipoles at the 440 ft. and also at a higher level, thus increasing the effective radiated power to 200 kW.

* * *

Stopping on the Railways

Whereas the decision to electrify British Railways with 25 kV alternating current using overhead equipment—as reported and discussed elsewhere in this issue—is a bold imaginative step designed to achieve maximum efficiency, that which covers the fitting of vacuum brakes to freight wagons is solely one of expediency. The need to equip all freight trains with continuous braking has been recognised for many years and a specific sum for this work was included in the railway's modernisation plan. Almost all passenger coaches hauled by locomotives and about 179,000 (out of a total of 1,126,000) wagons are already fitted with vacuum brakes; the British Transport Commission aim to have all their wagons equipped by the end of the 15 years allowed for implementation of the plan.

There can be little doubt that the £75 million which is to be spent in this way will give as great a return as any the railways will spend—even allowing for the £50 million that will be required for providing close screw couplings, fitting improved roller bearings in the axleboxes and employing a superior brake shoe to that used hitherto if full advantage is to be obtained from power brakes. Fitting these brakes brings some problems in its trail, however: trains will be more difficult to make up, stock will have to be better and will certainly require improved maintenance. But continuous braking is essential if traffic operation is to be improved so that the railways can offer effective competition to road haulage—especially if some new roads are built.

Whether or not the choice of vacuum brakes—in preference to air brakes—was sound seems to be open to question and the Commission have

been under fire from several quarters. When the scheme was announced Sir Brian Robertson—who described the decision as irrevocable—observed that it was realised that air brakes were the more superior technically, but that the replacement of the vacuum equipment already in use was too large to be contemplated; meanwhile, work on the vacuum brake would be intensified to increase its efficiency. True, the effective pressure of the vacuum brake is limited to atmospheric pressure whereas air brakes may reasonably operate at 100 lb. per square inch, but would the greater cost of the latter bring a worth-while improvement in operation? Undoubtedly it would, and engineers will regret the lost opportunity, but political realists will recognise the inevitability of the Commission's decision.

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For the Record

If we agreed with Henry Ford that "history is bunk" we should be confessing that experience is valueless, that in effect man only learns from his mistakes to make different mistakes. Fortunately, in spite of his success as a practical engineer, Ford's dictum is proved entirely false by the whole course of engineering progress. Technology consults the past to provide for the future, proceeding by a combination of foresight—seeing future needs—and hindsight—recognising past errors—and therefore cannot be independent of historical vision.

It is thus with some satisfaction that we learn of the preservation in libraries of bound volumes of ENGINEERING. The journal is written primarily for the weekly reader, but it serves too as a source of reference. Recently, the Skefko Ball Bearing Company presented to the Luton Public Library a set of bound volumes of ENGINEERING dating from 1899 to 1939, which they had received from their associate company in Sweden. It was felt that by making them generally accessible to Luton engineers they would serve a wider purpose than if limited to the company's own use.

In making the presentation Mr. A. Lamm, technical manager of the company, referred to the immense growth of engineering science since 1899 and quoted from the volume published in that year as evidence. Yet even then, apparently, we were deploring the lead taken by foreigners—this time the French—in the manufacture of motor cars, but defending the motor car itself against critics who declared that its engine "barks like a dog and smells like a cat." "Its reek," we said, "is certainly less objectionable than that of horse droppings, which the community accepts without a murmur." Our attitude towards electric traction, however, appeared to be less progressive. Commenting on another article of 1899, Mr. Lamm noted that the author seemed doubtful whether it would ever be economical to change from horse-drawn to electric traction.

No technical writer of to-day would be so incautious as to underestimate the scope of technical progress; he is more likely to err on the other side and see a Utopia of automation and atomic energy just around the corner. Perhaps to readers of to-morrow our optimism will seem as mistaken as our predecessors' reserve. But whether events prove us right or wrong, there can be no doubt that the world of to-morrow will be founded on the discoveries of to-day—and yesterday—and that recorded knowledge will always serve a useful purpose.

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Advice on the Use of Gas

When special problems arise in industry it has become increasingly the custom to call on the services of a specialist. Many firms provide services of this kind. The nationalised gas industry does, too. Although the industry is integrated into a whole, the Gas Act established that there should be twelve autonomous Gas Boards which would be responsible for meeting the needs of local consumers. The work of the Boards is centralised in the Gas Council, which also directs matters of research, Press relations and publicity as a whole. The local Boards have built up specialised knowledge of local industry and its particular requirements, for example, textiles in the North West, aircraft in the South West and steel in the East Midlands. Thus, in any area, whatever trade requires advice, information can be drawn from one of the other areas which has a specialised knowledge.

As a case in point, during an investigation into an insulation problem comparative tests were carried out on two similar annealing furnaces, one of which had 9 in. walls of firebrick backed by 4½ in. of high-temperature insulating brick, and the second had walls of 13 in. hot faced insulating brick. It was found that the second furnace used 14 per cent. less gas than the first during a week's use, in which time the outputs of the furnaces were equivalent. Another example occurred in drying match-sticks before processing, where the method of drying by drum was replaced by using an infra-red gas-fired tunnel, cutting the time from 30 minutes to four.

To ensure the continuity of service some of the Gas Boards have started training schemes for their industrial representatives. These last 18 weeks and include experience of industrial laboratories, appliance workshops and drawing offices. The trainee is then attached to an industrial gas engineer and goes round with him, and later with a heating engineer, to gain further experience.

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Imperial College Must Go On

The new buildings of the Imperial College of Science and Technology (an artist's impression of the new blocks in their surroundings is shown on this page) will provide space for 3,000 students by 1961. The college will occupy the greater part of an "island" site—of which it is now a part occupant—of 16 acres, which will be developed to provide about 500 sq. ft. for each student. Existing buildings to be left intact are those of the Royal School of Mines, the Department of Chemical Engineering, the Goldsmiths' extension of the City and Guilds College, the Royal College of Music (which contains one of the best concert halls in London) and some private residences at the south-western corner of the site of which the College has not secured possession. Among the buildings of which Londoners will be rid is the Imperial Institute.

A basically symmetrical layout has been found most suitable for future requirements. The architects propose five main spine blocks, four of which will be 120 ft. high and the fifth, or central block, 200 ft. high. At the centre of the south aspect, facing on to Imperial Institute-road, will be the new Great Hall. Though present plans now differ from that shown in the illustration. Between each of the main blocks are to be a series of gardens, terraces, covered passages and bridges giving access from the departmental blocks to the nucleus, composed of the central block and the Great Hall and containing the libraries, debating halls, refectories and offices. The life and work of the late Rector of the College, Sir Roderic Hill, will be commemorated by a garden laid out in the central quadrangle.

Ultimately, in a total of 3,000 students, the college hopes to have 1,400 post-graduates and altogether, with those who teach and minister to the students, there will be about 4,500 people working there. Most of the post-graduates will be taking advanced courses designed to train engineers of the highest calibre and specialising in subjects which must necessarily remain outside the syllabus of the first-degree course. It was in 1953 that the decision was taken to leave the College where it had grown in Kensington, and the publication of the basic conception of what may ultimately transpire gives encouragement that the work of construction, already begun, may continue.

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Imperial Institute Must Go

It is an unholy alliance of sentimental Victoriaphils, Labour lords and nostalgic imperialists which has been formed to defend the Imperial Institute. Whatever merits there are in the late Mr. Colcutt's elevation—and there is a certain wistful attractiveness about the tower—the plan of this forgotten building discloses that its sponsors soon tired of their project. Behind the pompous frontage there has never existed more than a hotchpotch of temporary exhibition buildings and an examination hall.

As for the permanent part of the building itself, Lord Beveridge, who worked in it as vice-Chancellor of London University, has made it quite clear that its architect failed to achieve what presumably distinguishes architects from pure artists or mere engineers: the combination of beauty with function. Whatever its artistic merits, it is not a building in which work can be done. At the present time its interior resembles nothing so much as one of those monstrous houses, built by Victorian businessmen to establish themselves as country gentlemen, during a war-time occupation by the rough soldiery: temporary partitions, filing cabinets, roughly printed notices and dirt. It is good that the Government appears unmoved by the clamour and seems determined that the Imperial College shall be enabled to complete its expansion in a manner worthy of the work it has to do.

Future buildings of the Imperial College of Science and Technology shown in the setting.

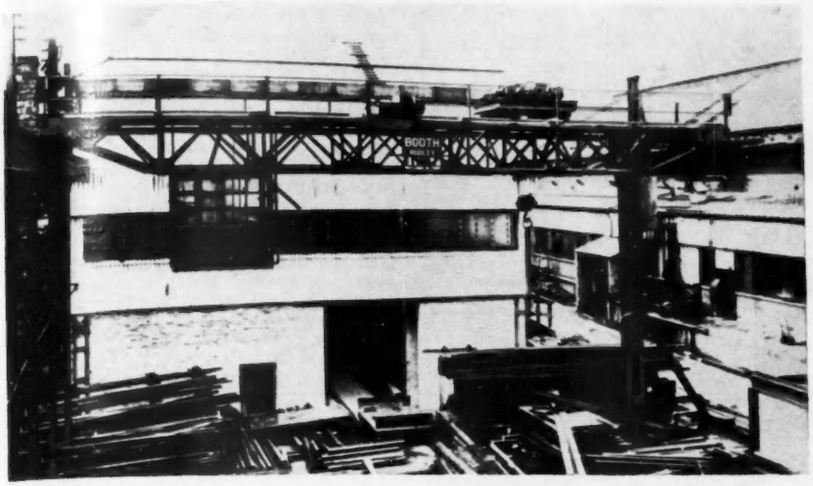

Fig. 1 The 5 ton electric overhead travelling crane at Rodley, which was tested for many different shock loading effects.

SHOCK LOADING EFFECTS IN OVERHEAD TRAVELLING CRANES

REVIEW OF DYNAMIC STRESS ALLOWANCES

By E. Lightfoot, M.SC.(ENG.), PH.D., A.M.I.C.E., A.M.I.STRUCT.E.*

It is impossible to operate a hoisting mechanism without producing dynamic stresses. Some of these stresses will arise in a crane no matter how carefully it is used, e.g., those due to passage over rail joints. In the hoisting motion dynamic stresses can be minimised by skilful handling, but the apparent response of a crane can be deceptive. Though "snatch" hoisting is infrequent, sudden halting during a lift commonly occurs and gives rise to considerable, but less obvious, dynamic stressing. Accelerating and braking, in the long and cross-travel motions of the electric overhead travelling (E.O.T.) crane, can be controlled to produce inappreciable stresses. But even with good handling, unavoidable and unexpected dynamic stresses occur, and need to be estimated for design purposes.

Some types of shock loading may occur accidentally or from irresponsible use; for example, when a crane is run into the end-stops. Deliberate misuse sometimes occurs: in the hoisting of overloads, in dragging plates and trucks, in lifting and placing loads outside the working area, etc. The designer may allow for some measure of accidental misuse, especially if it occurs fairly often, but it is uneconomical to design a crane for infrequent abuses which cause high additional stressing (unless the user particularly requires it).

A crane is designed so that the estimated stresses never exceed certain permissible values with normal usage. Every possible combination of stresses is considered, but permissible values may be raised for unlikely combinations such as, for example, wind gust loading occurring with maximum live loading. The most economical structure will usually be fully stressed, but in small cranes the design may be controlled by the sections available and by methods of joint construction.

The effects described below were investigated with this usual design method in mind; in any case it was not possible to test to collapse by overloading or fatigue. For the revised B.S. 466, "Electric Overhead Travelling Cranes for General Use in Factories, Workshops and Warehouses," a stress factor has now been proposed to allow for fatigue, but not in such detail as in B.S. 153 (for bridges). Faulty design may, of course, be vividly demonstrated by the occasional failure of a structure or part of it. Where such failures occur with unforeseen overstressing they clearly indicate where the design is at fault, and the remedy is usually apparent. Many structures, however, are both safe and uneconomical, and since failures do not occur, there are no direct lessons for improvement.

Economical crane design largely depends, therefore, on a more realistic application of the existing elastic design method. With increasing competition and the post-war steel shortage the codes of practice now sanction appreciably increased permissible stresses. Designs must therefore now be made to cover all permissible loading combinations with a correspondingly reduced margin of safety—hence the present interest in shock-loading effects. It is clearly important that the more adventurous designs of to-day should take adequate account of every reasonable loading contingency.

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CRANES TESTED

In the tests reported here three lattice-type E.O.T. cranes were tested; the first, on its erection trestles at Joseph Booth and Bros. works at Rodley, near Leeds, the second, also built by Booth's, at the Rotherham works of Steel, Peech and Tozer, Limited, and the third in the stockyard of Booth's own works at Rodley; the third crane is the subject of Fig. 1. These cranes had different spans and lifting capacities, and though they were all made by the one firm and were tested as they became available, it would be difficult to select a more representative three.

This programme of crane tests was started by the Civil Engineering Department of the University of Leeds in 1951. At about the same time the British Iron and Steel Research Association took on an investigation along similar lines with the particular requirements of the steel-making industry in view. The performance of tower cranes has also been studied at the Building Research Station. Research on cranes is also reported from Germany and Japan, and some of this work will be mentioned later. Operational research on cranes and excavators has recently been undertaken in the U.S.S.R.

DYNAMIC FACTORS FOR DESIGN

It is recognised that at least two overall dynamic factors are required to allow for dynamic effects in E.O.T. crane design, viz., to cover vertical and horizontal impulse effects. The vertical impulses may come from the hoisting motion and from running on bad rail-joints in the long-travel motion of the crane and the cross-travel motion of the crab. Of these, the hoisting motion usually determines this dynamic factor D_1 if the rail tracks are well-jointed, though the effects are not readily compared. In the horizontal direction the greatest impulsive effect on a crane comes from collision with end-stops or with another crane, though smaller effects are set up much more frequently by acceleration and deceleration in the long-travel motion. If collisions are regarded as contingencies to be designed for, the present method of designing for a horizontal shock loading of one-tenth the weight of the crane and the load seems inadequate, unless such a low allowance is justified on the grounds of infrequency. Accelerating and braking (even skid-braking) do not appear to produce very great stresses and the present factor seems to allow for these effects fairly well.

EXPERIMENTAL EQUIPMENT AND TECHNIQUE

The strain-measuring equipment used in the tests was built from standard components and gave quite accurate results.[1] It was found that the dynamic factor was nearly constant at arbitrary points on the crane girders in any particular hoisting test and so it was possible to use a single representative strain trace. Multi-trace recording was not required in the hoisting tests once this fact was established, but it was necessary in some of the other investigations. The equipment was carefully calibrated and found to handle dynamic stresses without any distortion. Calibrating resistances were used to provide a record of the scale for strain on the 35 mm. film. Thus strains could be measured from the film and compared with those set up by the static load; in most cases, however, it was possible to obtain the dynamic factor at once from the strain trace by dividing the maximum by the mean ordinate.

Hoisting speed was measured continuously by means of a small generator, shown in Fig. 2, connected to the second beam of the cathode-ray oscilloscope. Long-travel speed was measured similarly by means of a small generator driven by the long-travel shaft and was similarly calibrated for voltage against rotational speed and for number of turns per unit distance moved. These generators were belt-driven and gave an accurate record of the hoisting motion.

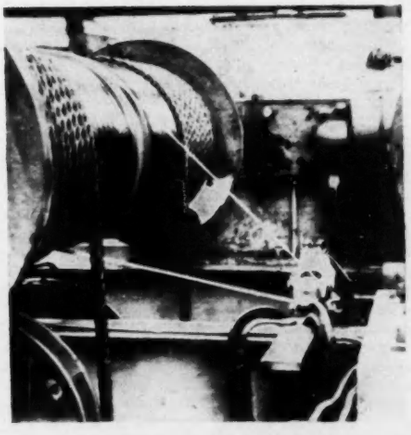


Fig. 2 Generator in position for measuring the winding speeds in some of the hoisting tests.

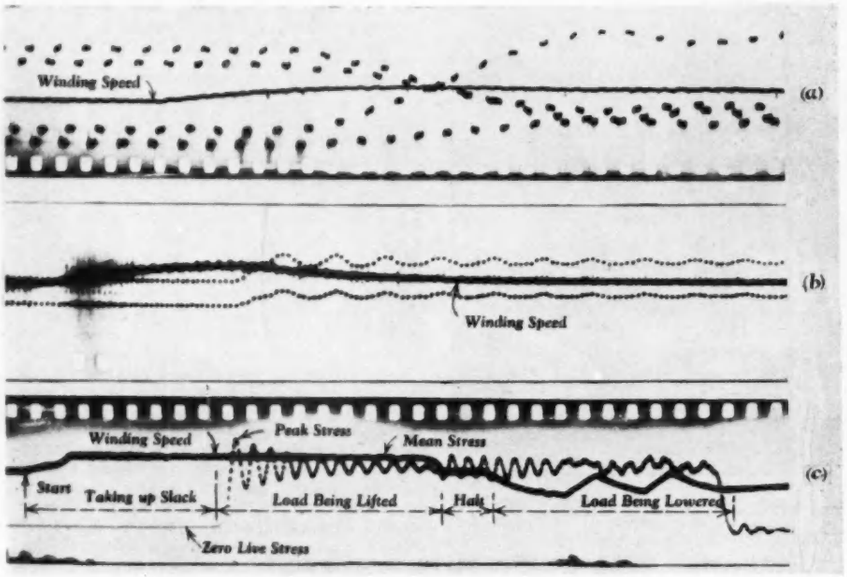


Fig. 3 Typical strain recordings of the hoisting tests.

Care was taken that the pulley belting was tightly tensioned, and the pulleys were cleaned with a grease-remover.

A projection method was used for scanning the developed film and for obtaining approximate measurements, but for accuracy a travelling microscope was used for measuring the dynamic strains—a tedious operation.

VERTICAL SHOCK LOADING IN THE HOISTING MOTION

Consideration of the Dynamic Stresses Produced.—The halting of the permissible load at the full " rated " hoist speed in a lift is probably the most usual effect, but because it leads to an initial reduction in stress it proves to be a difficult criterion for the estimation of the dynamic factor. Braking in the lowering motion is much too variable for use as a basis for a dynamic factor, since braking performances vary from crane to crane, and depend on adjustments in any particular crane. Although the lowering speed can be appreciably higher than the rated hoist speed the dynamic stresses set up by severe braking are usually comparable with those due to " snatch " hoisting, because the deceleration of the load never amounts to a sudden halt. The " snatch " lift of a load at the rated hoist speed seldom occurs intentionally but may occur accidentally or carelessly; it is adopted here as a criterion for D_1 because it is related to specified performance values for the crane, viz., the permissible load and the rated hoist speed. Other investigators seem to have accepted the snatch hoist as a natural criterion, though the sudden halting of the permissible load in lowering at the rated hoisting speed is simpler theoretically and should perhaps be preferred, though it is seldom realised in practice. The various experimental traces obtained show that the snatch lift gives a dynamic factor which is only exceeded occasionally by other effects in the hoisting motion.

Experimental Results.—Some of the traces from the tests are shown in Fig. 3. The first of these shows four intermittent stress (actually, strain) traces and a central velocity trace, with the ordinates representing stress and hoisting speed respectively, and horizontal distance representing time. This was a test on the first crane and a rotary switch was used in the mechanical switching, but was later replaced by a cam-operated switch, when a slower camera drive was also fitted. In Fig. 3(*b*) two traces are recorded along with the velocity trace in a test on the third crane. This same crane was tested again later and single traces were then obtained along with the velocity trace (which was then nearer to the theoretical case); a specimen film record for these tests is shown in Fig. 3(*c*). These traces show stresses of the order of 3 tons per sq. in. and hoisting speeds of the order of 5 inches per sec., with good accuracy.

Theoretical Analysis.—If the crane, the crab, the tackle and the load are represented as an equivalent spring system, as in Fig. 4, it is possible to investigate the dynamics quite easily. In hoisting from the ground, however, it is important to realise that two stages of motion have to be considered: the first before the load is lifted and during which the crane is deflected downwards and the tackle stretched, and the second stage which follows as the load is lifted. The terminal conditions for the first motion, which is in effect that of a single-spring system, are the initial conditions for the second motion, in which two degrees of freedom occur. In Fig. 5 the motion of the crane is plotted with respect to time for a hoist test on the first crane tested, and the speed and acceleration of the crane (at the crab) are shown along with the displacement. (The mathematical treatment will be found in a recent paper by the author and Dr. B. L. Clarkson[1].) The maximum force in the crane varies directly with the maximum displacement, in terms of the crane stiffness K_1.

The two simultaneous differential equations which describe the second motion may be solved by " classical " methods or, with considerable simplification, by means of the Laplace Transformation Method. It is possible to obtain an expression for the dynamic factor in terms of the crane characteristics and the speed of hoist, with the values of the crane speed and acceleration at the moment of lift also involved. Since these latter values are periodic (because the system is effectively one-spring only during the first motion) it is possible to relate the speed of hoist with these values in a simple fashion and so to obtain the relation between the dynamic factor D—or the " impact factor," $I = (D - 1)$ —and the speed of hoist. In Fig. 6, the I-V relation is plotted for a test on the stockyard crane at Rodley; it will be seen that a good agreement exists between calculated and measured values—showing that the assumptions made in the theoretical analysis (negligible damping, single mode vibration in the crane) and the experimental errors are together quite small. In all cases the theoretical approach described gives a close prediction for the experimental D value (see Table I, reference 1).

The difference between snatch hoisting from the ground and sudden halting whilst lowering at the same velocity and with the same tackle length is also explained in Fig. . The latter case corresponds to zero velocity and acceleration of the crane at the instant of hoist and this occurs for certain values only in a snatch hoist. Onishi and Kawakatsu[2] of Japan conducted a similar series of tests but ignored the difference between these two cases; consequently their calculated values of D differ considerably from the measured values. Very close values may be derived from their data by the present author's full two-stage analysis[1] and by the approximate formulae proposed by Eden[3] and the author.

It is also interesting to note that Cranz of Germany did not allow for the two stages of motion in a snatch hoist; in a recent paper[4], assuming a rigid tackle, he supposed the load to be lifted with a sudden impact, the crane being stationary at the instant of lift. In actual fact the crane at the crab is being moved down at the full hoisting speed in this case and there is then no impact since the load leaves the ground with zero initial velocity at this instant. The apparent paradox of zero displacement, velocity and acceleration holds for the lifting of a load by any simple spring system and is explained mathematically in that the first and second derivatives of the function $(t - \frac{1}{\omega} \sin \omega t)$ are both zero at zero time, as illustrated in Fig. 5.

Approximate Formulae for the Dynamic Factor.—If the equivalent mass of the crane and crab are neglected in the spring system depicted in Fig. 4, then a simple formula

$$D = 1 + \frac{V\omega}{g} \quad . \quad . \quad . \quad (1)$$

may be obtained for the dynamic factor.[3] Here, ω is the frequency of vibration, in rads. per sec., of the two equivalent springs taken together and the suspended load. This formula usually gives good results when it is calculated for the full working load (the case required for design), for then the relative effect of the equivalent mass of the crane and the crab is small.

A different formula, derived from controlled experiments, has been found to give improved results. It is

$$D = 1 + \frac{0{\cdot}9V}{m_s g}\sqrt{m_1 K_s} \quad . \quad (2)$$

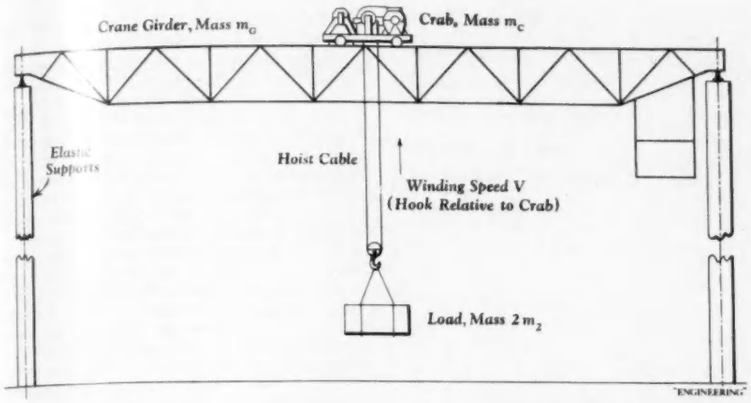
where $m_s g$ is the load lifted, m_1 is the equivalent mass of the crane and the crab, and K_s is the stiffness of the tackle. Even this formula may yet be improved, perhaps, though it covers most possible cases with good accuracy. As it is rather too involved for the designer, a formula

$$D = 1 + CV \quad . \quad . \quad (3)$$

has also been proposed by the author, in the hope of obtaining acceptance of the D-V linearity. Here, V is the rated hoist speed and C a factor depending on the crane classification. For most cranes in casual duty $C = 0{\cdot}10$ (with V in inches per sec.), but for heavy duty cranes $C = 0{\cdot}16$. Cranes are classified according to hours of usage per year; this governs the motor sizes and the design allowances and results in lighter or heavier construction. A similar distinction is made in the German specification.

A comparison of the way the approximate formulae predict the various experimental results is shown in Fig. 7, in which the actual value for the impact factor is divided by the various predicted values and the quotients (with each average value adjusted to unity by means of the factor C) plotted as ordinates against abscissae representing the various actual tests. In Fig. 6, page 172, certain experimental I-values are shown in relation to the hoisting speed and are compared with a theoretical I-V relationship and with formula (3) above and the present design ruling. It is apparent from these two figures that formula (2) gives better predicted values than other proposed methods, and that the simplified formula (3) gives more satisfactory values than the present allowance for the dynamic factor.

It is realised that the values given by this formula might be considered high by those



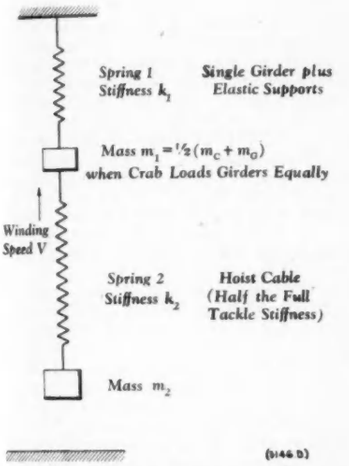

Spring 1 Stiffness k_1
Single Girder plus Elastic Supports
Mass $m_1 = \frac{1}{2}(m_C + m_G)$ when Crab Loads Girders Equally
Winding Speed V
Spring 2 Stiffness k_2
Hoist Cable (Half the Full Tackle Stiffness)
Mass m_2
(3146.D)

Fig. 4 Typical E.O.T. crane, and the equivalent spring system used in the theoretical analysis.

interested in steel economy. However, damping had already been allowed for in the original equation (2). Though formula (3) is related to the case where the tackle is wound in to 10 ft., this could easily occur, and the shock would most likely be produced with a sudden halt in the winding. In the new draft specification, steel economy has been achieved by raising the permissible stresses, for example, from 6 to 10 tons per square inch for bending compression (though the stress factor reduces this somewhat). With this provision in mind, therefore, there is more reason for the adoption of a safe dynamic factor. The effect of crane handling is, however, a matter which the crane makers and users are more competent to judge, and a reduction might be made in the above formulae if it is considered that the author has been unduly pessimistic in taking full "snatching" as a satisfactory criterion. (But see addendum.)

VERTICAL SHOCK LOADING DUE TO BAD RAIL JOINTS

When a wheel passes over a gap in a rail it sustains an impact which can be calculated for the idealised case as (the mass of the wheel) × (the width of the gap) × (the angular velocity of the wheel). By a similar method the impact due to passage over a difference in height at a rail joint can also be calculated; it is seen from this treatment that a difference in level has more effect than the same distance as a horizontal gap. The effect of the speed of travel is seen to be proportional above a certain value corresponding to zero-speed "toppling" impact, and this is roughly confirmed by the tests. (In his theoretical paper Cranz[4] considers the impact to arise from the speed attained by the wheel in falling freely in the vertical direction, but this gives no dependence on speed of travel.) Now with rail tracks the joint profiles are never truly horizontal and the gaps vary in width; there is also a lateral variation which is important because the wheels have a certain lateral clearance and movement. Because of this wide variety in rail joints even the impact on a simple wheel would be most difficult to estimate. With a crane the effect of the passage over rail joints would appear to be still more complicated and erratic.

Though the wheels supporting an E.O.T. crane are housed in the end carriages without any springing, the impact blow on a wheel (which might be taken as the effective mass of the wheel multiplied by the velocity of impact, as found above) is not transmitted throughout the crane at its full value because of the flexibilities of the end carriages and the crane girders. If a load is carried on a flexible tackle the spring system is further complicated. It is clear that the effect of a known wheel impact on stresses at any point of a crane girder would be most difficult to determine. Though it has been thought futile to attempt to predict theoretical stresses for the passage over bad rail joints the experimental results are given below with comments.

It is noted, in passing, that the stresses set up in a vehicle with sprung wheels in moving over variations in road profile have been investigated at the Road Research Laboratory.[5] In the case encountered here, however, the wheels are unsprung; this problem does not seem to have been given any earlier attention, except by Madsen.[6]

In 1940 at Bethlehem, U.S.A., Madsen[6] of Lehigh University measured the dynamic stresses produced in a crane girder when the crane was run over oak wedges placed on the track. De Forest scratch gauges were used in this work, but the electric resistance strain gauge is now in current use and gives more reliable results. During tests by members of the Department of Civil Engineering of the University of Leeds on a stockyard crane at Rotherham in 1952, Madsen's tests were repeated with steel wedges at a maximum height of 0·28 in. It was found that comparatively severe stresses were set up at the mid-span of the crane girders as the leading wheels of the crane passed over the wedges simultaneously, and these are shown in Fig. 8. Since such wedges are equivalent to a rail gap of about 5 in., in this case, they are considered to be unrealistic, but the tests at least indicate an extreme case of this type of shock loading.

Later in 1953, further tests were made on a stockyard crane at Rodley, Leeds, when a special gap of 0·8 in. was made on one rail only and traversed by the crane at varying speeds. It was found that the shock loading in passing over this gap at full speed was equivalent to an impact factor of about 25 per cent. based on the stress due to a load of 5½ tons. In passing over a normal rail joint of 0·12 in. width at the same speed, the impact factor was about half this value, as is shown in Fig. 9.

These tests have confirmed that the dynamic stresses due to passing over rail joints increase with long-travel speed and with decrease in tackle length, as might be expected. Though the dynamic stresses arise from an impact which depends in magnitude on the mass of the crane as well as that of the load, the tests show that a dynamic factor, based on the working load (though this is somewhat illogical) is still within that required to allow for hoisting—for the two cranes tested. This conclusion is substantiated by the experimental results of some other investigators.

There is clearly room for further research work on this problem, but it does seem that the effect of bad rail joints will actually determine design for vertical shock loadings in some cases. With good tracks the effect should be low, and with welded joints there should be less likelihood of this effect setting up stresses greater than those due to hoisting. In the German crane specification (which is also under revision at present) vertical "travelling" factors are given for both riveted and welded joints. These are: $\epsilon = 1{:}10$ for a long-travel speed of 1·0 m. per second on riveted and of 1·50 m. per second on welded rails, and $\epsilon = 1{:}20$ for higher speeds. This seems to be a reasonable basis for design until more information is available. These factors, of course, apply to total stresses due to self-weight and live loading.

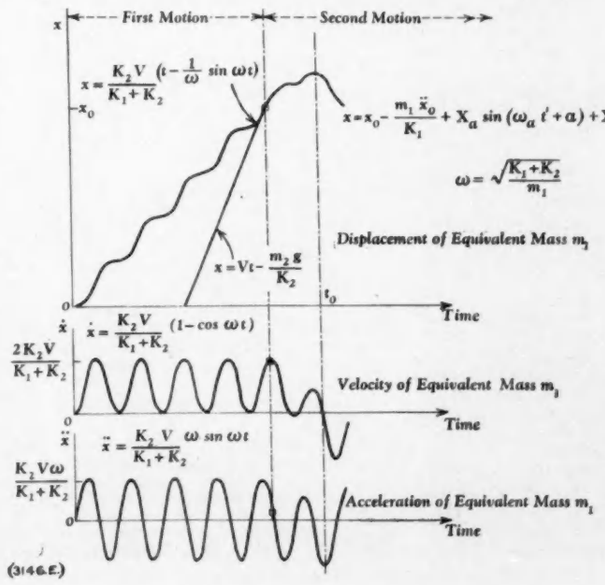


Fig. 5 Curves of girder displacement, velocity and acceleration calculated for a snatch hoist with a central 30-ton load and a winding speed of 2·37 in. per sec.

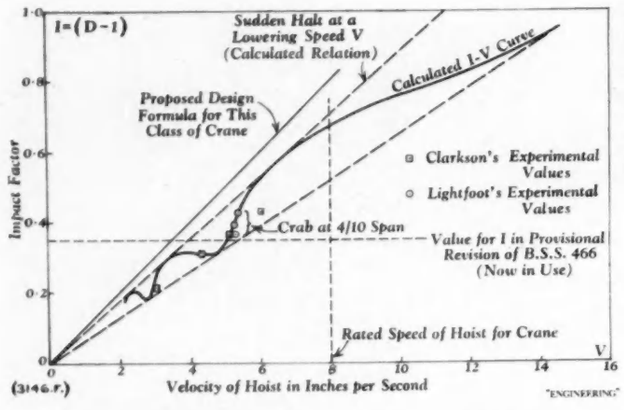

I=(D-1)
Sudden Halt at a Lowering Speed V (Calculated Relation)
Calculated I-V Curve
Proposed Design Formula for This Class of Crane
Clarkson's Experimental Values
Lightfoot's Experimental Values
Crab at 4/10 Span
Value for I in Provisional Revision of B.S.S. 466 (Now in Use)
Rated Speed of Hoist for Crane
Impact Factor
Velocity of Hoist in Inches per Second
(3146.F.)
"ENGINEERING"

Fig. 6 Relation between velocity of hoist and impact factor during a snatch hoist. The load lifted was 5·25 tons with the crab located at three-sevenths span.

The cross-travel motion of the crab as it carries the load from one end of the crane to the other sets up very small dynamic stresses, probably because the rail joints are usually much better than on the gantry and the cross-travel speed is slower. The friction of the wheels in producing the motion sets up crane surge which has little effect on crane girder stresses but may be important in gantry girder design.

HORIZONTAL SHOCK LOADING

Due to Accelerating and Braking.—It is difficult to distinguish between stresses set up in a crane girder by acceleration or deceleration in the long-travel motion and stresses caused by passage over bad rail joints, particularly since the damping is so small. Attempts have been made to separate these stresses by assuming the pattern due to rail-joints to continue when the additional stresses due to accelerating or braking come on, but such a division can only be of doubtful accuracy, for the stress variations already present are usually quite irregular. However, it is possible to measure the accelerations and decelerations quite closely from the velocity-time trace (except when skidding occurs). In the tests on the 10 ton magnet crane at Rotherham, with the crab carrying an 11·8 ton load at the centre of the crane, it was found that:

Max. acceleration possible ..	0·016 *g*
Deceleration with power cut off ..	0·016 *g*
Deceleration with L.T. motor reversed (one stop)	0·021 *g*
Deceleration by foot brake only ..	0·031 *g*
Deceleration due to foot brake and L.T. motor reversed (with skidding on dry rails)	0·173 *g*

In this extreme braking test the actual deceleration of the crane would certainly be less than that indicated, because of skidding which affected the measurement.

The stresses produced in the main bottom boom of the unloaded crane were measured for this case of extreme braking. The theoretical stress trace was derived from a calculation allowing for the lateral flexibility of the crane and for the mass of the crane and the crab (which was positioned at mid-span). In such a simple spring system the maximum force would be the equivalent mass times twice the deceleration, and the equivalent mass would be that of the crab plus half that of the crane girders. Now from swinging load tests the effect on stresses of an alternating horizontal load at crab level can be measured, and with this as a calibration (confirmed later by static load tests) the theoretical stresses were predicted for this case of maximum braking. It was observed at once that the theoretical values were very high, and this may be ascribed largely to the error in measuring the braking; clearly an accelerometer should have been used (but was not available during the tests). The actual stress traces are interesting, however, for they showed virtually zero effect from the braking—the pattern was altered, perhaps, but there was no apparent increase in stress.

Similar tests have been conducted by other investigators but it has been found that the superpositioning of horizontal inertia and rail-joint effects has made deciphering of the stress traces very difficult and uncertain. Tentative stress predictions have also proved to be at considerable variance with measured values.

In contrast with this recent work, Madsen's tests may appear to be much more satisfactory. Using a rather inaccurate stop-watch method for measuring speed variation in starting and stopping, and using scratch gauges for dynamic stresses, Madsen found that crane braking was of the order of 0·1*g*, and that stresses calculated on this value were between 1½ and 2 times the measured stresses. This research was used as the basis for the A.I.S.E. specification for E.O.T. cranes used in the U.S.A., in which the lateral force for design is taken as 20 per cent. of the weight of the crane minus the end-carriages plus 20 per cent. of the maximum working load, all multiplied by the number of driven crane wheels and divided by the total number of crane wheels. This recommendation is used in B.S.466 as a simple 10 per cent. (the usual value in the A.I.S.E. specification) and a very similar clause is incorporated in the German specification.

It seems that this 10 per cent. valuation gives ample allowance for lateral inertia loading, but that a reduction might be possible if indicated by more exact experimental results. It is also fairly certain that the flexibility and length of the tackle would permit a smaller percentage of the lifted load to be taken, since the effective spring stiffness of a pendulum is low and the maximum deceleration would usually be over well before the tackle reached its maximum obliquity.

Due to Running into End-Stops and Other Cranes.—On some gantries the end-stops consist of steel chocks with contact curves which fit the end-carriage wheels exactly. There is, therefore, an instantaneous reduction in velocity upon contact, and the impact is particularly severe on the end-carriages. The effect on a crane driver is so sudden and unpleasant that these stops are carefully avoided, and it is claimed, with some justification, that this method of limiting the crane travel is more satisfactory than the use of spring buffers. Such buffers often require constant attention, for cranes frequently run into them once they are fitted.

In some tests made on the stockyard crane at Rodley the stresses at the mid-span of the girder were measured at the same time as the long-travel speed. The method of measuring speed cannot be considered accurate for the duration of impact, but there is no reason to doubt the strain gauge readings. It is seen from the traces that there is a considerable difference in the stresses set up due to running into these end-stops and into spring buffers (each of stiffness about 0·7 ton per in.).

These tests were not sufficient to allow any theory to be checked—the phenomenon would have to be investigated allowing for the impacts on each side not occurring together. The effect on the crane is considerable and would clearly rule design for lateral loading if it was to be regarded as permissible usage. It is perhaps safer to leave the design method as it is, provided mild steel is used and that circumstances keep the magnitude and the frequency of the effect

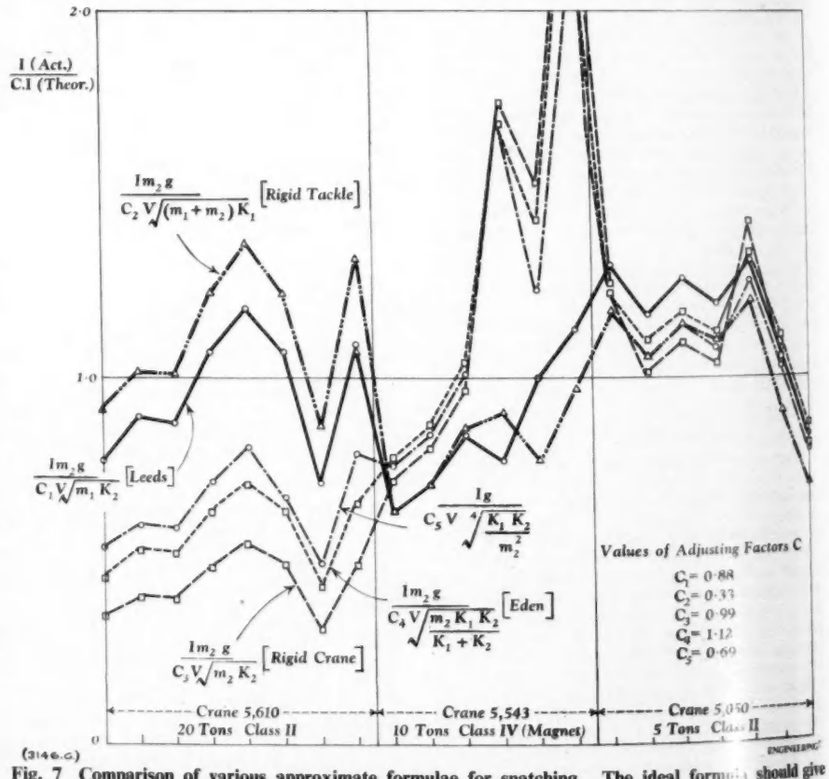


Fig. 7 Comparison of various approximate formulae for snatching. The ideal formula should give a trace very close to the 1·0 ordinate, with an adjusting factor, C, somewhat less than unity (to allow for damping).

inversely related. Nevertheless, general adoption of spring buffers would be a definite advantage so far as crane girder stresses are concerned.

CONCLUSION

This research on dynamic stresses in E.O.T. cranes indicates that the structural design will be satisfactory if it is based on a logical dynamic factor for hoisting and an adequate lateral loading allowance. Rail tracks should be kept in good repair and the rail joints kept close and even, in which case the stresses set up will be covered by the allowance for hoisting. Though collisions and some other accidental shocks cause high stresses they are usually infrequent enough to be disregarded. Failures due to reckless usage should be left as the user's responsibility, as at present, for it is impossible to design for them economically.

Acknowledgments.—The author is indebted to Dr. B. L. Clarkson for collaborating in most of the work, and to Joseph Booth and Bros. of Rodley, Leeds, and Steel, Peech and Tozer, of Rotherham, for permission to test cranes and for many additional facilities. The testing was conducted as part of the research work proceeding in the Department of Civil Engineering at the University of Leeds, under the general supervision of Professor R. H. Evans, D.Sc., M.I.C.E., M.I.Mech.E., M.I.Struct.E.

ADDENDUM

Recent research work on dynamic forces in cranes has lately been reported from Sweden.[7] The findings on the dynamic factor D_1, occurring with full load and at maximum hoist speed, are very similar to those obtained by the author, though only a single equivalent spring is considered. However, the effect on D_1 of the position of the crab is included, though it is accepted that only the central position need be taken for design. From traces obtained during the working of four different cranes, it was found that $0{\cdot}6 \times D_1$ was exceeded only once in 20 working cycles. This observation would appear to justify a reduction in the values proposed by the author, which are based on full snatch hoisting.

For stresses arising due to passage over bad rail joints a travelling factor, ϵ, is already in use in the German specification. Though it is related to the entire weight of the load, the crab and the crane girders, the stresses calculated from this factor have not been found here to exceed those due to the impact factor taken with the lifted load. A theory for this factor, ϵ, is now derived by Johnsson in his recent paper,[7] by allowing for the inertia effect in a single crane girder when one wheel suddenly passes over a difference in rail level. It is shown that the crane wheel does not leap clear of the rail when normal joints are encountered, and that ϵ can be expressed as $Ah + B\sqrt{h}\,v$, where A and B are functions of the crane characteristics, h is the difference in rail height at the joint and v is the speed of travel. For the crane tested there was a wide scatter in the plotted results, but the mean line found by least squares agreed quite well with the theoretical curve. The new Swedish Crane Standard uses this work and gives:

$\epsilon = 0{\cdot}3 + 0{\cdot}6\,v$, for rails with joints,

$\epsilon = 0{\cdot}03 + 0{\cdot}03\,v$, for rails without joints,

where v is in metres per second. These expressions give rather higher values than those obtained by Johnsson.

For the three Booth cranes tested, the additional stresses calculated from the first of these formulae for ϵ are less than those obtained by multiplying the working loads by the new B.S. impact factors. But in Sweden, apparently, higher stresses are expected from passage over bad rail joints than from hoisting. In the German specification, both effects are added, but they can hardly occur together in practice. The possibility of coincidence of the full impact factor for hoisting with the maximum travelling factor is estimated as about 1 in 200 by Johnsson. In the new Swedish design practice, the maximum travelling factor is taken with a twice-reduced dynamic factor, as indicated by a theoretical probability method.[7] But the impact factors taken separately for design seem to be remarkably low.

There is clearly scope for yet more research work on these cranes, for though much has been accomplished there are still many outstanding problems.

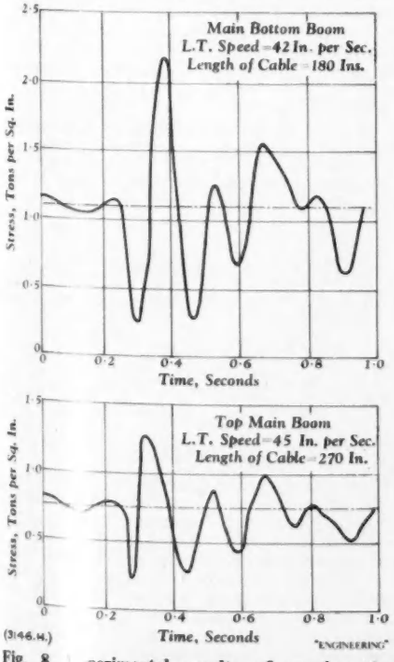

Main Bottom Boom
L.T. Speed = 42 In. per Sec.
Length of Cable = 180 Ins.
Stress, Tons per Sq. In.
Time, Seconds
Top Main Boom
L.T. Speed = 45 In. per Sec.
Length of Cable = 270 In.
Stress, Tons per Sq. In.
Time, Seconds
(3146.H.)
"ENGINEERING"

Fig. 8 Experimental results of running the crane over wedges placed on the rails.

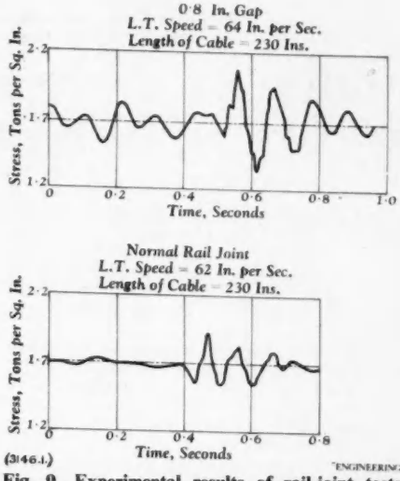

0·8 In. Gap
L.T. Speed = 64 In. per Sec.
Length of Cable = 230 Ins.
Stress, Tons per Sq. In.
Time, Seconds
Normal Rail Joint
L.T. Speed = 62 In. per Sec.
Length of Cable = 230 Ins.
Stress, Tons per Sq. In.
Time, Seconds
(3146.I.)
"ENGINEERING"

Fig. 9 Experimental results of rail-joint tests, (above) with a 0·8 in. gap, (below) with a normal rail joint.

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RADIO VALVES FOR ARDUOUS CONDITIONS

New Manufacturing Plant Installed

New manufacturing units have recently been installed by the M.O. Valve Company, Limited, at the Osram-G.E.C. Lamp Works, London, W.6 to enable large numbers of high-reliability valves to be assembled under semi-laboratory conditions. The installation has been made necessary by the increasing numbers of special quality valves now being required for electronic apparatus for the Services; valves which not only suffer no change in their characteristics throughout life, but also are able to withstand great accelerations and operate satisfactorily under conditions of severe vibration and shock.

In the first section, component parts of the electrode systems, themselves manufactured to rigid specifications, are assembled on benches specially designed to prevent contamination by dust or other airborne particles. The working spaces are swept by a steady current of filtered air, and the assembly room as a whole is air conditioned and maintained at a pressure slightly above atmospheric. As an additional precaution the assembly operators and other personnel wear overalls made of a non-fibrous yarn such as nylon, and enter and leave the room through an air lock.

The spot-welding machines used in the assembly operations are thyratron-timed and fitted with automatic pressure control, reducing the possibility of human error to a minimum.

The electrode systems are inspected and, complete in their glass envelopes, are passed through an air lock into the pumping room, where they are sealed to the envelopes and evacuated. At the end of this process the pip on the glass envelope is positively moulded to a predetermined shape to give it added strength.

To ensure reliability of the special quality valves, they are given stringent tests after manufacture. Every valve is aged and subjected to routine tests and all valves are run for not less than 50 hours under normal operating conditions. They are then re-tested for characteristic stability.

Sample valves are selected from each production batch and subjected to inspection tests. A number of samples is tested to end of life under static conditions as a check on their expected lives. Other valves are fatigue tested under vibration at varying frequencies. The resistance of valves to shock acceleration is also tested on a special machine where the valves are mounted in holders which are given a violent blow from a swinging hammer to impart to them a momentary acceleration of about 500g. This test is carried out with samples mounted successively in four different positions.

Samples of valves having flexible leads are given a lead-strength test in which a weight is hung on each lead-wire in turn and the valve repeatedly twisted from side to side. Others from each production batch are immersed in boiling water for a short period and then immediately plunged into ice-cold water; the thermal shock experienced will reveal any weakness in the glass. During these reliability tests, the remainder of the production batch is held for a minimum period of 28 days, after which the characteristics of all valves in the batch are re-tested as a final check on their storage properties.

The Engineering Outlook—7

TEXTILE MACHINERY

FAVOURABLE EXPORT PROSPECTS: STABILITY AT HOME

There is a noticeable contrast at present between the climate of some sections of the textile industries and the delivery performance of the textile-machinery manufacturers. For some time now there has been deep gloom in Lancashire about the future of cotton textiles and there has also been something of a recession in wool, although in this last case rather better trading conditions developed during 1955. In contrast, the hosiery industry has been prosperous and jute enjoyed better trading conditions in 1955 than in 1954 to judge from the figures for the first nine months of the year. Overall, however, the outlook for textile machinery is very much conditioned by the prospects in cotton and wool textiles, apart from makers of specialist machines who cater for certain sections of the hosiery trade. A report issued in May, 1955, under the auspices of O.E.E.C. went as far as to say that unless there was a radical alteration in production methods, "the final result will be a gradual disappearance of the European textile industry." Cotton, wool and jute were specifically mentioned as faced with the prospect of a gradual decline. So far as this country is concerned, the outlook for cotton textiles was serious enough in the closing months of 1955 for the Cotton Board to consider calling a conference on the concentration of production on a smaller number of units. In December, a first meeting from all sections of the industry met to discuss the future structure of the trade.

Against such a background the delivery figures of textile machinery in 1955, make remarkably good reading (see Figs. 1 and 2). In the third quarter of 1955 total deliveries of textile machinery were £17 million compared with £18 million in the previous quarter and with about £19 million in the last quarter of 1954. Such figures bespeak something approaching stability and give little hint of the difficult long-term prospects which face the cotton and wool textile industries of Western Europe.

By tradition, textile machinery is mainly an export trade. The figures in Table I show exports to have increased in 1955 by 10 per cent. It is to be noted that judged by last year's performance, India is still the most important market depite the growth of the local industry. On the other hand, business with Pakistan was already falling off, partly owing to a shortage of Sterling. Western Germany took rather more machinery than in 1954, and France was still a big customer. Such potentially important markets as Brazil showed an improvement on the year but exports to Latin America in general were still well below the potential which could be tapped if currency restrictions were removed. The trade returns, however, by the nature of their compilation are somewhat out of date and Pakistan and Germany, for example were not as important markets by the close of the year as they have been in other years since the war. Western Germany can now provide its own textile machinery and has a surplus at competitive prices for export. The currency situation in Pakistan has not eased the position for textile machinery imports.

LARGE RUSSIAN ORDERS

For these reasons it is broadly true to say that the recent good performance in export markets, with one important exception, has been due to a proliferation of orders from a large number of countries, especially those which are conscious of their newly acquired independence rather than to large, sustained orders from traditional markets.

The exception mentioned above is Russia. In 1955, orders for about £7 million of textile machinery, mostly for wool textiles, were delivered. These orders are nearly complete but they must have represented something of the order of £5 million of exports in 1955, which are not shown separately in Table I. It is clear that so far as the export market is concerned, the favourable showing in 1955 owes much to this large order.

As already mentioned, business in the home market has remained remarkably stable in 1955. In the third quarter of the year deliveries were about £8 million compared with £9 million in the second quarter, £9 million in the first quarter and £9 million in the last quarter of 1954. There was therefore no immediate reaction to the worsening prospects for the Lancashire cotton trade as measured by deliveries of textile machinery. It is noticeable too, that the steady rate of delivery through the year was not caused by an expansion of deliveries to the hosiery industry and a fall elsewhere, but by a remarkable conformity of the trend of deliveries of each subsection to the total figures already quoted.

It might be said, of course, that deliveries in the later months of 1955 are a poor indication of sentiment in the opening months of 1956, but even the order position is better than might be expected. Export orders on hand are not much below those at the same time a year ago, althought the big Russian order is now running out.

It was reported in the Press some time ago that Russia is interested in ordering about £20 million of machinery and if this figure is reliable there is still about £13 million of business to be obtained. A British group is in Russia at present to negotiate further orders. If anywhere near the same size of order from the Russians can be obtained this time, the export orders for textile machinery could be in excess of those in the early months of 1955. It is clear also that an improved foreign exchange position in, say, Brazil or Pakistan could make the order position in 1956 exceedingly satisfactory. It is not easy to assess the likelihood of a further big Russian order. There are signs of competition for it from the U.S. and there is always the possibility that the Russians will cut down subsequent orders to some extent by making copies of what has already been delivered.

COTTON IN THE ROUGH

The position of orders for the home market is thought to be rather less satisfactory, particularly in the case of cotton. In 1955 almost 70 mills were closed down in Lancashire and two textile-machinery manufacturers announced a significant laying off of workers, in one case amounting to the closing of a factory. On the other hand a new spinning plant was opened at Bolton (significantly to spin synthetics) at an estimated cost of £250,000 and there is still scope for further modernisation among the big combines as soon as trade for cotton textiles improves. The larger groups have already undertaken formidable modernisation programmes since the war and many of them still have the will and the finance to modernise further, as soon as the turnover justifies such a policy.

It would be wrong to see the future of the

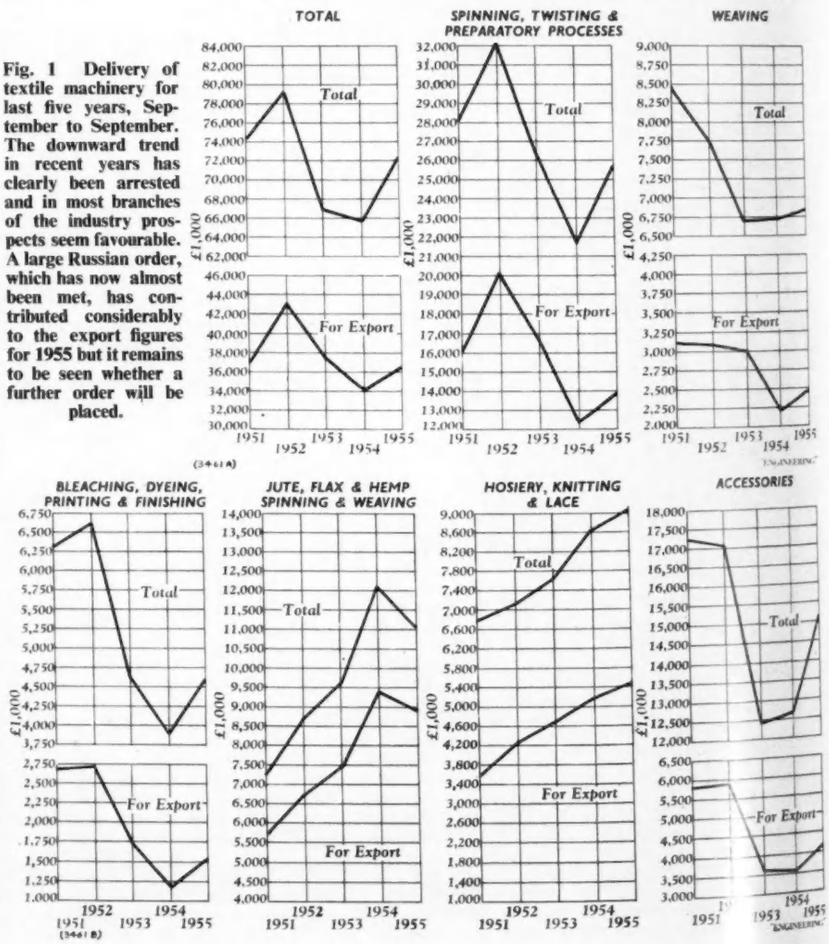

Fig. 1 Delivery of textile machinery for last five years, September to September. The downward trend in recent years has clearly been arrested and in most branches of the industry prospects seem favourable. A large Russian order, which has now almost been met, has contributed considerably to the export figures for 1955 but it remains to be seen whether a further order will be placed.

textile-machinery industry of this country in terms of gradual decline no matter how categorical the O.E.E.C. report may be in its opinion about the future of much of the European textile industry. It is true that the future of the home market is problematical and that many countries abroad which formerly bought British textile machinery are now making their own but there are still a large number of countries which would buy British equipment if their foreign exchange reserves permitted. In this respect the medium-term outlook is far from gloomy although it may be some time before countries like Argentina and Brazil can freely admit foreign machiney. Furthermore, in the long run it has to be remembered that the tremendous drive now developing to raise the standard of living of the undeveloped areas of the world by large-scale capital investment will create employment and earnings which people will wish to turn in the first place into food and secondly into clothing. The scope for providing such people with cheap textiles from this country may be small but there will be a much bigger opportunity for providing them with the machines to make the clothing locally. China is an outstanding example of this.

MULTIPLE SHIFT WORKING

So far as the home market is concerned, a number of new factors are fast developing. It is possible that a redundancy scheme for cotton textiles may be evolved this year and although this might be accompanied by a temporary loss of confidence in the cotton textile industry it is by no means unlikely that the concentration of production on more efficient and financially stronger units might be to the advantage of the textile-machinery industry. One unsettling factor this year will be the break-up of the Calico Printers' Association which is abandoning price-fixing and percentage quantum schemes "under duress" from the Government acting on the recommendations of the Monopolies Commission. This move may well create a period of uncertainty at the finishing end of the trade.

A vital issue for the textile-machinery makers is the prospect of multiple shift working in Lancashire cotton mills. Some progress was made in 1955 when the spinning unions agreed to co-operate with the Master Spinners' Federation in introducing multiple shift work with due safeguards to the operatives. It had been hoped that the cotton weavers would join with the spinning operatives in agreeing, in principle, to this move but so far this has not happened. The spinners are obviously in favour of the idea and the discussions last autumn may well be the thin end of the wedge. Multiple shift working may now be only a question of time. In so far as this is so, the prospects for raising the amount of capital equipment employed per operative are improving—a prospect which is bound to benefit those who make machinery. Such a progressive step could be hindered if delayed too long by the continued drain of labour from the mills.

It is difficult to say at this stage what the effect on textile-machinery makers is likely to be in the long run of the increased use of synthetic fibres. The weaving of mixtures has been growing for many years and the arrival of Ardil, Terylene and nylon as well as the development of non-creasing properties of acetate rayons for woven and knitted goods have become a feature in the cotton, wool and hosiery industries.

HOSIERY AND JUTE

Last year the trading results of the hosiery industry were good on the whole and the trend away from natural fibres to synthetics continued. The increased use of nylon, Terylene, Orlon and Ardil continued to be noticeable and rayon was still giving way to the newer synthetic materials. The effect of the continued credit squeeze on consumer purchasing in 1956 remains to be seen. If, however, the purchasing power of the public is maintained and the pattern of expenditure is similar to 1955, there is no reason why the hosiery industry should not continue to enjoy prosperity in the home market. There was a fall off in exports of hosiery to South Africa and Australia in 1955 and any improvement in exports must await a relaxation of the Australian import cuts which were imposed last year. The outlook for the hosiery-machinery manufacturers is, however, satisfactory, for the industry of recent years has shown a willingness to invest in new kinds of machines, particularly large companies which have been going for mass-produced lines and have adequate financial resources for capital development.

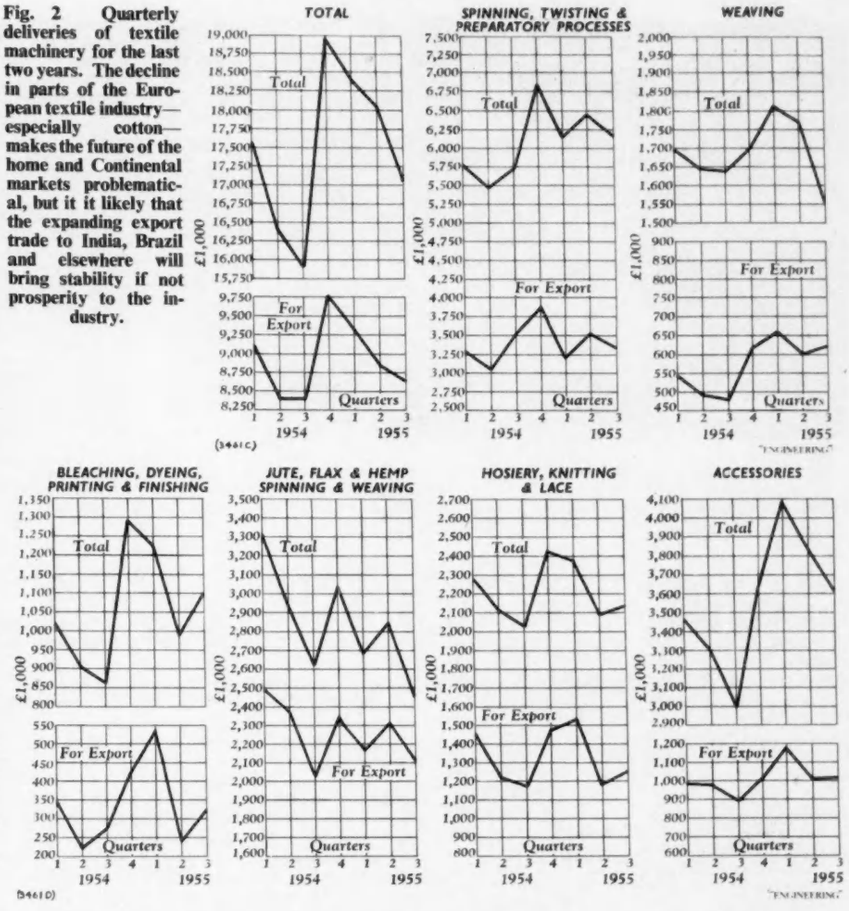

Fig. 2 Quarterly deliveries of textile machinery for the last two years. The decline in parts of the European textile industry—especially cotton—makes the future of the home and Continental markets problematical, but it it likely that the expanding export trade to India, Brazil and elsewhere will bring stability if not prosperity to the industry.

The jute industry continues to provide a fairly steady market for new machinery. Under its post-war modernisation programme this industry spent £6·8 million over the 10 years 1945 to 1954 on new machines. To judge from the trend of deliveries of machines (after subtracting an allowance for flax and hemp equipment) it would appear that in 1955 this average rate was at least sustained. It is probable that this rate of investment will continue for some time provided the general prosperity of the country is maintained. In the last few years the jute industry has been gradually putting into effect the work-study recommendations which were broadly laid down some years ago when the industry's basic wage rates were fixed by work study undertaken by consultants. In as much as work study, if followed through correctly, brings with it an improvement in methods of manufacture and a constant check on those methods, there is what might be termed a natural tendency for a high rate of investment to become established in the industry. This investment is likely to be aimed at increasing the rate of output per operative for a declining labour force rather than providing the basis for a large expansion in output. The industry is mainly concerned with increasing its efficiency to produce a comparatively stable level of output rather than planning a large-scale expansion. Under such conditions the rate of investment must slacken off in due course but it is not likely to do so to any great extent for another year or two. That the jute industry takes its modernisation seriously is further underlined by the announcement at the annual meeting of the British Jute Trade Association in Dundee towards the end of the year, that there would be a 40 per cent. increase in floor space in its administration block and new physics laboratories.

MACHINES FOR SYNTHETIC FIBRES

There have been a number of developments over the last year in the technology of spinning and weaving synthetic fibres. A new machine has been developed to cut synthetic fibres into short staples and twist it into a spun yarn in one operation. In November last year British Nylon Spinners Limited made arrangements with other manufacturers to supply equipment for making their new Agila baulked yarn. These yarns are becoming increasingly popular and are specially treated to combine bulk with lightness; this should increase the variety of textures available in finished fabrics. A number of new products were shown on British stands at the International Textile Exhibition at Brussels in June, 1955, among which was a new type of shuttle-changing loom which is both non-stop and fully automatic. This was a direct result of research work among Lancashire rayon manufacturers. An outstanding exhibit among wool textile machinery developments was a preparing and spinning machine developed by a Yorkshire company which has now been adapted on the Continent by worsted manufacturers who have to use dry-combed tops and must have no twist in the sliver before the actual spinning operation. It has also been adapted for long-staple synthetic fibres. Another interesting development in textile machinery was the

TABLE I.—United Kingdom : Exports of Textile Machinery, by Countries

	Quantities (1,000 cwt.)			Value (£1,000)		
	1953	1954	1955	1953	1954	1955
Union of South Africa	52	43	42	1,248	1,023	1,053
India	312	303	307	6,933	6,863	7,296
Pakistan	194	314	226	3,310	5,297	4,299
Hong Kong	19	13	8	476	334	226
Australia	55	57	65	1,614	1,823	1,981
New Zealand	9	6	15	262	260	471
Canada	32	32	19	1,042	1,099	811
Other Commonwealth countries	27	14	29	596	327	627
Irish Republic	41	34	30	771	699	613
Finland	33	6	22	735	251	692
Sweden	19	9	17	643	360	472
Norway	6	4	5	210	186	173
Denmark	11	7	6	360	287	227
Poland	10	27	1	266	689	34
Western Germany	47	51	55	1,616	1,816	2,130
Netherlands	47	54	42	1,180	1,265	1,020
Belgium	53	38	45	1,365	1,043	1,232
France	75	62	64	2,579	2,278	2,118
Switzerland	6	6	6	243	266	267
Portugal	33	23	25	764	516	591
Spain	21	25	10	544	629	370
Italy	150	81	28	3,386	1,986	1,083
Austria	8	9	11	252	331	391
Greece	10	16	8	242	438	277
Turkey	34	36	29	697	815	707
Belgian Congo	14	3	2	300	103	55
Egypt	21	38	51	523	994	1,255
Iraq	13	3	3	302	93	84
China	10	1	2	255	63	78
Japan	23	22	8	569	583	266
United States of America	43	25	54	1,525	1,017	1,932
Mexico	33	27	47	809	660	1,053
Columbia	5	11	14	121	291	382
Peru	10	12	12	259	354	369
Chile	6	3	4	166	125	216
Brazil	118	11	30	2,637	309	860
Uruguay	2	7	6	87	249	220
Argentine Republic	3	7	8	75	347	381
Other foreign countries	78	147	298	1,771	3,385	6,983
Total	1,683	1,587	1,654	40,733	39,454	43,295

TABLE II.—United Kingdom : Exports of Textile Machinery, by Main Machinery Groups

	Quantities (1,000 cwt.)			Value (£1,000)		
	1953	1954	1955	1953	1954	1955
New:						
For making synthetic fibres	23	22	21	709	792	747
For spinning and twisting and all preparatory processes	932	935	991	20,750	20,934	23,524
For processing preparatory to weaving but subsequent to spinning and twisting	48	65	62	1,319	1,842	1,869
Looms and other weaving machinery	308	254	254	5,267	4,089	4,584
Bleaching, dyeing, printing and other finishing	111	85	102	2,749	2,153	2,671
Hosiery and other knitting	46	52	54	4,610	5,152	5,371
All other textile machinery	69	59	55	2,014	1,902	1,905
Accessories separately consigned:						
Bobbins	8	7	7	315	280	264
Boxes and Cans	12	10	8	203	154	127
Card clothing	26	18	20	1,415	975	1,063
Pirns, cones and tubes	10	7	9	207	161	168
Reeds and Healds	5	5	5	207	183	158
Shuttles	3	5	6	215	242	261
Second Hand:	82	63	60	753	595	583
Total	1,683	1,587	1,654	40,733	39,454	43,295

new 168 in. knitting loom made by F.N.F. Limited. This compared favourably at Brussels with a corresponding German machine and appears to have overcome the rigidity and vibration problems associated with high-quality production with conspicuous success. It was recently announced that F.N.F. have concluded an agreement with the Kidde Manufacturing Company of New Jersey, U.S.A., whereby the American concern will make the F.N.F. high-speed warp knitting machine in the United States under licence. In return, F.N.F. will be able to manufacture under licence the well-known Kidde Knitter which it may make or sell in any country in full competition with the American product except in the United States and Canada.

In carpet manufacture, Tufting Machinery Limited announced last year the introduction of a new carpet tufting machine with a high rate of output. This has been primarily designed for the manufacture of both cut pile and loop pile carpets and is claimed to be suitable for any kind of tufting process such as t.welling, candle-wick and uncut moquettes. C interest to the smaller concern because of its inexpensiveness is a new cloth-inspection machine introduced by Mercury Limited. It has extendible legs and quick action with positive stops and three speeds which are easily changed. In April, 1955, Pasolds Limited claimed to have solved the problem of removing tension from knitted fabrics by means of a new dryer. Fabrics processed in this way are stated to be relaxed and shrink resisting, giving a considerable saving in time, space and manpower with an output double that of the conventional dryer.

In conclusion it may be said that the outlook for wool textile and hosiery is better than for cotton, while jute may enjoy steady if unspectacular prosperity. As and when the under-developed territories raise their standard of living, export opportunities for textile-machinery makers could well increase if prices and delivery are right. At home, the outlook for the textile industry is very mixed but the recent work study undertaken in the wool textile industry and the signs of progress towards multiple shift working in cotton could well bring important orders to machinery makers. It needs only a steady improvement, not necessarily a textile boom, to bring this about.

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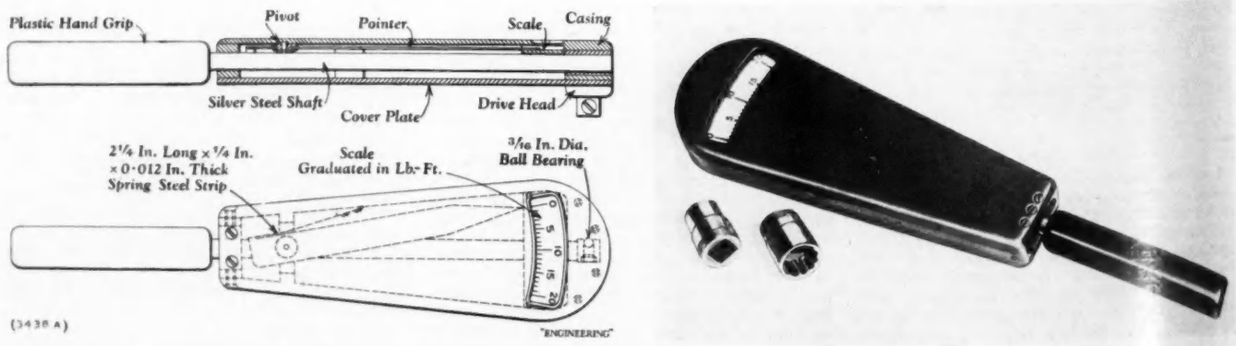
TORQUE SPANNER

Tool for Assembling Radio Valves

One method of making the final vacuum seal on some special types of radio valve is to clamp a ring of gold wire, the ends of which have been fused together, between the copper body of the valve and a closing member of the same material. To make such a seal the faces of the copper must be machined so that they are free from defects. For this purpose the valve is mounted in a steel clamp and baked at 400 to 500 deg. C. so that the gold diffuses into the copper, a process which is assisted by the pressure exerted by the clamp.

One type of clamp consists of steel plates, which are held together by a number of bolts. To ensure even pressure over the whole area these bolts have to be tightened the same amount. This can be done by an experimental graduated torque spanner, which has been designed by the research laboratories of the General Electric Company, Limited, Kingsway, London, W.C.2.

The spanner, shown below right, is intended for use with sockets to suit standard nuts. The square drive end carries the case and scale of the instrument, and the handle is a tempered silver-steel shaft with a plastic hand grip. This shaft carries a pin which engages with a pointer pivoted on the case of the spanner, the free end of the pointer moving over a scale graduated in pounds-feet. When using the spanner the torque applied to the nut causes the steel shaft to bend and the amount of bending varies the reading on the scale. The range of the spanner is from 0 to 20 pounds-feet.



Plan, elevation and general view of a graduated torque spanner, which has been developed for assembling special types of radio valves.

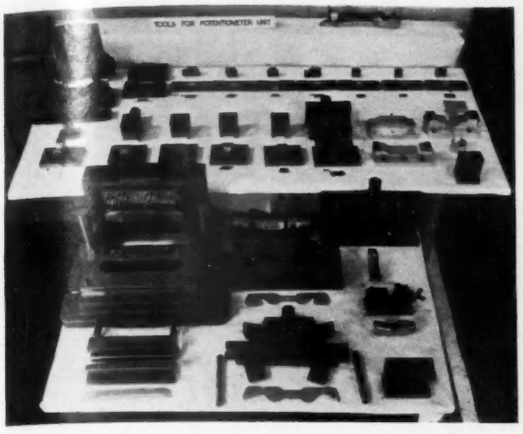


Fig. 1 Tooling for 600 strain-gauge potentiometer units, designed for simplicity and standardisation. Designing the tools and programming their manufacture were undertaken as a training project by post-graduate students at Cranfield.

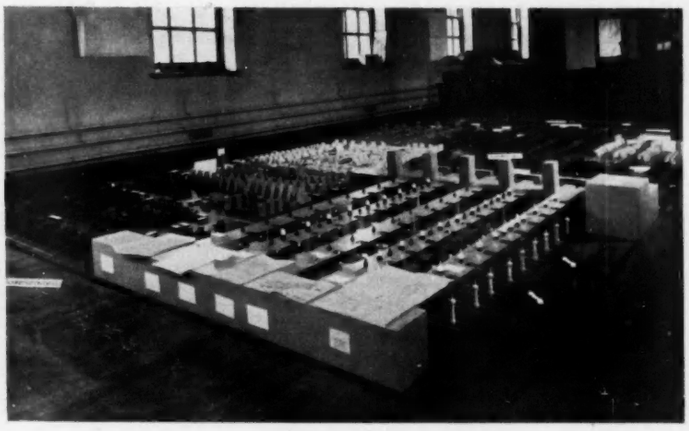


Fig. 2 Projected factory for turbo-propeller engine production; in the foreground is the assembly area, the main sub-assemblies being built up on overhead lines and lowered when complete on to the main lines, of which there are nine, at the appropriate stage. The finished-part stores is at the rear of the assembly area.

PRODUCTION ENGINEERING TRAINING AT CRANFIELD

PROJECT PLANNING AND RESEARCH FOR INDUSTRY

In 1949, when the post-graduate College of Aeronautics, Cranfield, inaugurated a Department of Aircraft Economics and Production, young professional engineers in the aircraft industry generally showed little interest in this important aspect of aircraft engineering; opportunities and training had directed their talents largely towards design, development or research activities. It is still true that graduate students entering Cranfield straight from the universities show preference for the aerodynamics, propulsion, and design departments, but, as a result of the intensive and successful efforts of the College staff to provide a realistic course for its production students, the industry is becoming increasingly aware of the value of these trained men and is readily absorbing these Cranfield graduates into their production departments. A number of overseas students and service personnel, also, now take their place in the production school.

The two-year course at Cranfield embraces three main aspects—administration and business methods, production engineering, and work study. The latter has already been the subject of an article in ENGINEERING (July 30, 1954, vol. 178, page 140), and we propose here to describe some of the work of the production engineering section, which is under the direction of Mr. J. Cherry, A.M.I.Mech.E., A.M.I.Prod.E., A.F.R.Ae.S.

Throughout the two-year course, great emphasis is placed on the economics of production engineering, and the necessity for designing the most economical tooling to produce the required quantity to the desired specification. The curriculum includes the study of processes, machine tool economics, the machinability and formability of the materials likely to be used in aircraft manufacture, process planning and estimating, machine loading and factory layout, jig and tool design, metrology and inspection processes.

HIGH-PRECISION STANDARDS ROOM

In order to demonstrate good manufacturing techniques and to provide students with facilities for carrying out their own researches, the department has its own machine shop, with a selection of the principal standard lathes, milling machines, grinders and gear cutters in use in industry; a press shop equipped with a rubber bolster press converted from an old baling press, which has recently been adapted for Redux bonding by the addition of a 3 ft. by 18 in. heated platen, a fly press, a hand-rolling machine used in studies on forming integrally stiffened skins, a pneumatic riveter, a 100 ton double-acting blanking and forming press, and a stretch-wrapping machine.

The standards room, temperature controlled, is unusually well equipped. In addition to the type of instruments found in a work's standards room, it provides for high-precision metrology, with a Kosters interferometer used for calibrating the master slip gauges by which in turn the inspection gauges are calibrated. A Johannson Mikrokator high-magnification comparator, accurate to within $\pm$ 0·000,005 in., and a Zeiss involute form tester for gears, believed to be the only one of its kind in the United Kingdom, are among the precision instruments available.

The heat-treatment laboratory actually belongs to the Materials and Metallurgy Department of the College, but its facilities are available to production students both for demonstration and research purposes. These facilities include, in addition to heat treatment furnaces for light alloys, a special furnace for the precision-controlled treatment of aircraft steels, a case-hardening furnace and cyanide plant, and salt baths; and a foundry with both electric-arc and high-frequency melting furnaces.

PRACTICAL TOOLING EXERCISES

As already noted, realism is the keynote of the Cranfield production engineering course, and whenever possible students are assigned real tasks and are charged with the responsibility for their satisfactory completion. An example of this is the strain gauge potentiometer unit (an assembly of about 30 parts) the tooling for which is illustrated in Fig. 1. 600 of these units were required for a 600-channel strain-gauge recorder to be used by the aircraft design department. A group of students was given the task of designing the necessary tools, programming the manufacture of the tools, and "trouble-shooting" in the workshops.

The tools were to be designed for economical production, therefore simplicity and standardisa-

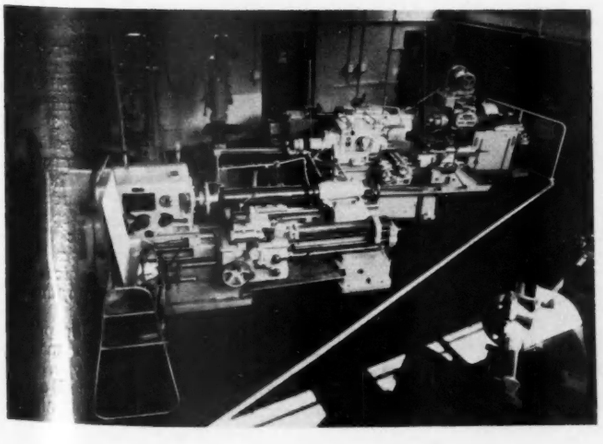


Fig. 3 The 25 h.p. lathe in the foreground of the machinability laboratory is used for cutting research on difficult alloys and heavy duty work.

Fig. 4 Forming a Redux-bonded panel in a stretch-wrapping machine (left) similar in principle to the Hufford type.

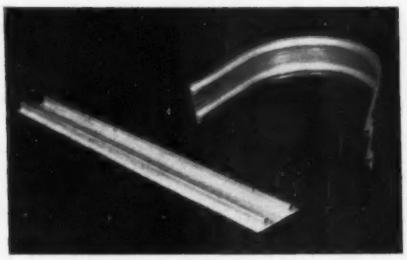


Fig. 5 The upper Redux-bonded panel has been successfully stretch-formed to a radius of 6 in.

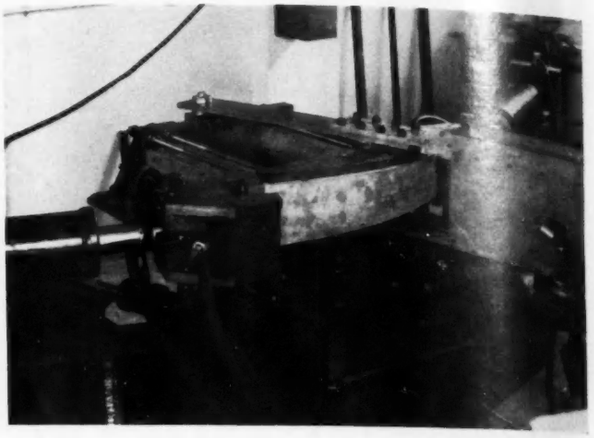


Fig. 6 The stretch-wrapping machine adapted for the production of unsymmetrical integrally-stiffened skins by the addition of a hydraulically-loaded friction roller which is traversed towards the wide end of the panel as the tension load is increased, thus ensuring uniform elongation.

tion were the predominant features. The die-set in the backgreund of Fig. 1 is a typical example: ten different contact plates are pierced and blanked by merely interchanging the blanking punch and die. Economy and accuracy of die manufacture is attained by making it slightly undersize in soft mild steel, and bringing it to its final dimensions by pressing the case-hardened mild-steel punch through, thus eliminating hand finishing.

FACTORY LAYOUT AND PRODUCTION PLANNING

In their second year, students are engaged in two major tasks—the " project," in which they work as a production team, and the writing of a thesis based on a piece of original research.

The project is designed to give experience in the proper treatment of industrial problems for their best solution. It provides practical experience in the use of all the lecture and educational material given in the course. Realism and responsibility are fostered by operating the project as a series of board meetings in which the students are members of the board and are responsible for investigating the problems as they arise and reporting their results to the full board, including staff members.

The project consists of the formation of a company, assessing the necessary capital and designing all facilities for the organisation, planning of production, production control, cost and financial control and administration. It integrates all sections of the department and unifies the teaching programme.

Concerning the production engineering aspects of the projects, drawings are obtained from the aircraft design department, who are themselves concerned with a similar type of project from the design aspect, but since design precedes production, it is the previous year's design project that the production students handle.

Working from these drawings, the students plan the processes and produce estimates; select suitable machines ; compile machine loading charts and determine the total number of tools required; design the factory layout; and design typical jigs and fixtures for selected components. At the weekly board meeting of students and staff, progress of the work is discussed, each student in turn acting as chairman or secretary, the latter being responsible for compiling the weekly progress report. Each student is assigned responsibility for one department of the factory —process planning, machine selection, and laying out.

The whole factory is laid out in model form on the floor, as illustrated in Fig. 2 which shows the 1955 project—a turbo-propeller engine factory. The different manufacturing departments are arranged to give a smooth flow to finished-parts stores adjacent to the assembly department.

For the desired production rate, nine assembly lines are laid down, sub-assemblies of the high-pressure turbine, low-pressure turbine, high-pressure compressor, low-pressure compressor and reduction gearing being carried out on an overhead floor, as seen in the right foreground of Fig. 2, and lowered on to the main lines at each stage as the engine progresses towards completion. The finished parts stores are located at the farther end of the assembly bay.

Since it is clearly not possible to design the tools and jigs for every detail of the project, typical components are selected and a thorough analysis is made of the machining processes, sequences, tools, gauges and labour required, and a detailed estimate is made of the machining times, using the methods learnt in the work study department. This analysis is then followed by the design of suitable tools and equipment.

MACHINABILITY INVESTIGATIONS

As already mentioned, second year students are required to produce a thesis on some piece of fundamental research. At the beginning of the year, the lecturing staff compile a list of problems currently confronting the aircraft manufacturing industries. From this list each student selects a subject for research, which he carries through on his own initiative, aided by discussions with the staff. Since the amount and type of equipment that can be made at Cranfield is limited by time and money, usually the student confines his efforts to proving the principle of his thesis and merely scheming out the final apparatus.

Up to the present these investigations have followed two main programmes—the machinability of aircraft materials, and the forming of aircraft components.

One of the objectives of the machinability research section is to compile data on the more difficult aircraft materials and to present this information in a convenient form readily applicable to the estimation of production times so that standards of performance can be set with reasonable accuracy. The work being undertaken currently includes the machinability and grinding of the materials titanium, Rex 448, the Nimonic alloys, and a heat-treated steel (B.S.99) with an ultimate strength of 90 tons per square inch. It is the intention to build up the research section so that *ad hoc* investigations can be conducted for the aircraft industry.

In Fig. 3 can be seen a small part of the machinability laboratory; in the foreground is a 25 h.p. lathe used for cutting research on titanium, Nimonic alloys and heavy duty work such as negative-rake machining. In order to measure the cutting forces and to assess the best tool shapes, a three-component tool dynamometer has been evolved by the Cranfield staff which resolves the cutting force into three components; and a two-component drill dynamometer is used for measuring drill thrust and torque. Instruments similar to these Cranfield dynamometers have now been adopted by a number of the technical colleges and manufacturing research departments.

During the past year investigations have been conducted into lubrication of cutting tools for machining Nimonic alloys, titanium and Rex 448, using Hi-Jet, oil mist and carbon dioxide as cutting fluids. The Hi-Jet principle attempts to reduce the friction between the cutting face of the tool and the work piece by injecting a stream of lubricant up the flank of the tool. The disadvantage of the Hi-Jet method is a considerable fuming that occurs during cutting, which would necessitate the provision of fume extraction equipment. In each case, however, beneficial results were obtained in comparison with normal lubrication and cooling methods. A detailed report on these researches is now being prepared.

RESEARCH ON FORMING

Among the students' work on forming, which was in the first place concerned with research into the forming process and the establishment of criteria and data for successful forming, are investigations on stretch-forming DTD 390 and 610 alloys; stretch-forming integrally-stiffened structures, symmetrical and unsymmetrical; and forming after Redux bonding. The work on integrally-stiffened structures included the machining of test panels held in a specially-developed vacuum chuck, as well as stretch-forming and roll-forming. The factors affecting buckling, springback and mechanical properties were derived and the best wrapping and setting conditions were determined.

Fig. 4 shows a Redux-bonded panel in process of forming on a stretch-wrapping machine similar in principle to the Hufford type. This machine was designed and constructed at the College of Aeronautics from surplus aircraft

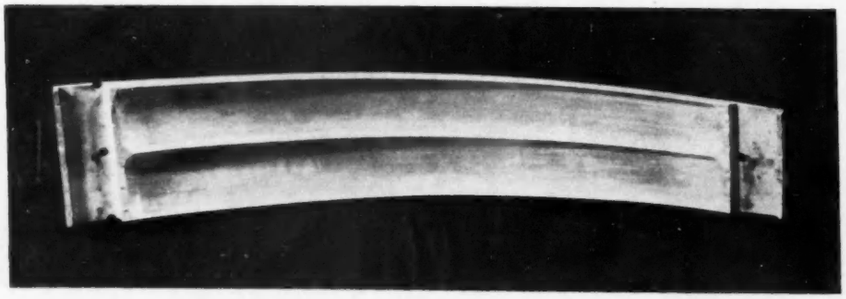


Fig. 7 An unsymmetrical panel successfully formed by the machine shown in Fig. 6.

hydraulic jacks and standard structural steelwork. Fig. 5 shows one of these Redux-bonded panels formed to a radius of 6 in. The tests were carried out on both Redux and Araldite-bonded skin-and-stringer panels in 22, 20, 18 and 16 s.w.g. DTD 610B light alloy. In the Redux-bonded specimens there was no case of a bond failure either during or after forming. Araldite-bonded panels, however, were found to be less suitable for forming after bonding.

Fig. 6 shows the same stretch-forming machine adapted to permit unsymmetrical integrally stiffened panels to be formed. A pressure roller operated by a hydraulic jack and mounted on a stirrup arrangement is brought into contact with the face of the panel to apply a frictional load. This roller is rotated progressively along the panel from the small end to the larger end, while at the same time the stretching pressure is increased progressively, thus permitting uniform elongation to take place in the panel. A panel successfully formed in this manner is illustrated in Fig. 7.

In the current research programme, in addition to the work already described, investigations are being conducted into spark machining; the economics of applying automatic control to machine tools for the aircraft industry; vibration techniques for improving the mechanical properties of Nimonic 75 and HR Crown Max castings; the repair of modern military aircraft; high temperature properties of spheroidal cast iron; and the measurement of large skin panels; as well as several subjects connected with other sections of the department. It should be understood that, in parallel with the production engineering aspects dealt with in this article comparable work is carried out in the work-study and business-methods sections of the Department of Aircraft Economics and Production.

GATE-END BOX AND CONTACTOR UNIT

New Flameproof Mining Equipment

The gate-end and contactor unit illustrated below has recently been added to the range of flameproof mining equipment made by A. Reyrolle and Company, Limited, Hebburn, Co. Durham. The unit, which complies with the National Coal Board Specification No. P3/1950, is suitable for the direct starting of squirrel-cage motors driving coal-cutters, conveyors and loaders and has a rating of 80 amperes at three-phase voltages up to 650 volts. It has been designed to simplify installation and maintenance, and to facilitate extension to similar units.

CONSTRUCTIONAL DETAILS

As regards construction, the welded-steel case has two separate flameproof compartments which are placed one above the other. The upper compartment accommodates the 300 ampere busbars and a triple-pole reversing isolator which is capable of breaking the normal current in emergency. The design allows access to this compartment to be obtained by removing a light-alloy cover. The lower compartment contains a framework, which carries the contactor and the control, protection, and auxiliary apparatus. This framework and the equipment on it can be drawn forward on rails for inspection and maintenance. It can be completely removed from the case after disconnecting the leads from the terminal board at the front. The cover of the lower compartment is also of light alloy. Two alternative fixing arrangements are available. That shown below uses a number of bolts operated from a single spindle by a loose key, but conventional multi-bolt fixing can also be employed.

PROTECTIVE ARRANGEMENTS

The contactor is held in electrically and is generally similar in design to that of an earlier unit. Over-current protection is provided by two series trip-coils with time-lag dashpots, the latter having a double-action characteristic to suit the starting conditions of the motor. Three multi-range trip-coils are available to cater for normal load-currents of 5 to 20 amperes, 15 to 60 amperes, and 30 to 80 amperes.

Earth-fault protection is provided by a ring-type core-balance transformer and a direct-acting relay with contacts in the operating-coil circuit of the contactor. The transformer is suitable for currents up to the full rating and tripping occurs with a primary fault-current of 0·5 ampere. The relay latches out after operation and can be re-set manually by a shrouded hexagon-headed screw in the front cover. A shrouded push-button is also provided on the front cover for checking the operation of the earth-fault protection by injection testing.

The earth-fault protection can also be locked out electrically. The lockout circuit, which is certified as intrinsically safe, includes the earth fault and is energised at 30 volts from the voltage transformer. The circuit energises the earth-fault relay, which opens the circuit of the contactor coil, trips the contactor and prevents re-closure until the circuit has been de-energised by removal of the fault. The lock-out circuit also functions should a fault occur while the contactor is de-energised and thus prevents closure on the fault.

INTRINSICALLY SAFE CIRCUIT

The new unit is normally remote-controlled, pilot-core protection being provided by an intrinsically-safe circuit, which inherently ensures continuity of the earth circuit. The contactor will not close, and if already closed will open, in the event of the trailing cable and/or the operating pilot-cable developing a short circuit between pilot and earth cores or a break in the earth or pilot cores. At the same time the trailing-cable plugs are electrically interlocked, since their withdrawal would be equivalent to a break in the pilot and earth-return circuits. The intrinsically safe circuit, which is generally similar to that designed in conjunction with the National Coal Board, is supplied with uni-directional rectified alternating current. It includes a pilot relay with a closed secondary circuit which is designed on the operating magnet system. A 15 ohm resistor is inserted in the pilot circuit after the contactor has been closed by earthing the pilot circuit through the half-wave rectifier. The current in the pilot circuit is thus limited to a value which will hold the relay in position, but which will not allow it to pick up should the contactor trip owing to failure and subsequent restoration of the supply.

With this control arrangement, a short-circuit in the pilot circuit cuts out the half-wave rectifier and energises the pilot relay with alternating current. The closed secondary circuit then de-magnetises the relay, so that it cannot operate. Similarly, the pilot relay, being de-energised, does not operate if a break occurs in the pilot circuit. Thus, with either type of fault, the pilot relay by failing to operate, breaks the operating-coil circuit of the contactor, tripping the contactor if it is closed, and preventing it from operating if it is open.

A selector switch enables local, remote, or sequence control to be used. Standard trifurcating boxes or "flit" plugs for the incoming cable can be fitted to the ends of the busbar chamber. The outgoing circuit is connected to a 100 ampere four-pin British standard plug and socket which is mounted on the front of the unit, as specified by the National Coal Board. Provision is made on the bend of the socket for mounting a direct-connected ammeter. A terminal box for up to four pilot cables can be fitted on the right-hand end of the unit.

An 80 ampere flameproof gate-end box and contactor unit which has been designed by A. Reyrolle and Company Limited for controlling squirrel-cage motors driving coal cutters and other mining machinery.

★ ★ ★

INVESTIGATION OF LOW-FREQUENCY PHENOMENA

Philips Electrical Limited, Century House, Shaftesbury-avenue, London, W.C.2, have designed an osilloscope for investigating low-frequency phenomena such as occur in mechanical engineering when using strain gauges or vibration pick-ups. It has a sensitivity of 180 millivolts root-mean-square, but by using a built-in coupled amplifier this can be increased to 500 millivolts for frequencies between 1 cycle and 100 kilocycles. Although the low-frequency response is good, pulse voltages are reproduced with negligible distortion.

Identical amplifiers with symmetrical coupling are used for both horizontal and vertical deflections. In both cases the input impedance is 2 megohms and about 50 picofarads under working conditions. The time base, which is either free running or triggered, can be controlled continuously or in steps from 0·1 to 15,000 cycles.

There are three built-in calibration voltages of 0·1, 1·0 and 10 volts. Automatic fly-back suppression is included and the trace can be amplified five-fold both horizontally and vertically. Three different cathode-ray tubes with varying persistance are available, each of which has a screen diameter of 10 cm.

Book Reviews

WHERE ENGINEERING MEETS CHEMISTRY AND PHYSICS

Chemical Engineering. Vol. II: Unit Operations. By J. M. COULSON and J. F. RICHARDSON. *Pergamon Press, Limited, 4-5 Fitzroy-square, London, S.W.1.* (60*s.*)

During the present century the growing chemical industries found a need for men who could tackle new problems by a scientific approach rather than by the application of ready-made rules. These problems varied enormously; some seemed more suitable for applied chemists, some for applied physicists. The common feature of them all was the requirement of originality of mind combined with an engineering outlook. The amalgamation of these has been the basis of chemical engineering as a distinct profession, having its own field of service and training discipline.

To justify the dignity of being recognised as a distinct profession, any occupation must demonstrate that it gives service in some unique field of endeavour. That of chemical engineering was developed by applying to the chemical process industries the cardinal principle of continuous steady-state flow. This principle necessitated a preoccupation with the *rate* at which transfer takes place, and here transfer is meant in its widest sense: the transfer of heat, of matter, and momentum. As a consequence, the education of chemical engineers developed not as a narrow specialisation but rather as a broadening of the ordinary general engineering or applied-science courses.

In the evolution of chemical engineering education, besides a necessary preliminary study of fluid mechanics, heat transfer and chemical combination, it has become customary to submit to analysis the procedures found in all industries where matter is changed in composition or structure. These procedures, such as distillation, filtration, size reduction, etc., were classified as "unit operations," and the study of these, and the processes in which they occur, has served as means of integrating the basic fundamental studies.

The early text-books on chemical engineering emphasised procedural methods, that is, the "know-how" rather than the "know-why." Of recent years, there has been a steady production of specialised texts relating to some particular aspect of what are still referred to as "unit operations," and these have put more emphasis on the analytical side. The growth of university schools of chemical engineering since the war is producing a tendency to depart from the unit operation classification, and to push the study even further back to the "transfer processes" involved. The specialised texts on the whole did this, but there was no single text-book of chemical engineering which was adequate to serve as a university text-book for honours degree students.

Chemical Engineering, by J. M. Coulson and J. F. Richardson, in two volumes, was designed primarily to fill this need. The authors have long experience in lecturing to chemical engineering students, and they have both made significant contributions to the subject. The first volume, published in 1954, was devoted to the basic processes of fluid flow, and heat and mass transfer. It was almost universally well received, although it was criticised in some academic circles for a certain lack of rigour of theoretical treatment, but the criticism was relatively minor and the appearance of Volume II was eagerly awaited.

It is largely concerned with unit operations. So far as possible the grouping of these unit operations is made so as to facilitate discussion from the basis of fundamental principles. The first section is based on the flow of fluids pats particles, and comprises gas and liquid flow through tower packings, filtration and centrifugal separation. The next considers systems involving relative motion between a fluid and particles, and covers sedimentation, fluidisation and conveying, and gas cleaning. The next section is the most important and is concerned with the applications of mass transfer. Under this heading come leaching, distillation, absorption of gases, and liquid-liquid extraction. There is then a section describing evaporation, crystallisation, and drying, while the final section is concerned with size reduction, classification of solids, and mixing.

The method of presentation of the subject matter reflects the authors' long experience in teaching. Students will be grateful for the inclusion of all the steps in the mathematical derivations, and for the inclusion of numerical examples worked out in the text. The authors have also adopted the system of having certain sections printed in smaller type. These contain the more difficult theoretical features, and can be omitted at first reading. The emphasis on derivation from first principles does not mean that descriptive matter is wholly neglected. On the contrary there is a great deal of it, amply illustrated by line drawings and photographs. This feature of the book is certainly not less important than the analytical side. Because of the breadth of study necessary in chemical engineering, university lectures [illegible] the whole deal almost entirely with analysis [illegible]nd leave the student to become acquainted w[illegible] the descriptive parts of the processes by hi[illegible]own reading. The authors have catered for this a[illegible]mirably.

The choice of subject matter, and more particularly, the relative emphasis placed on it, must be a matter of personal selection. Thus, sedimentation, fluidisation and conveying receive detailed treatment, which reflects the interest in this subject by one of the authors. On the other hand, in the section on distillation, while use is made of the enthalpy-composition diagram for the solution of the simple separation of a binary mixture, this most elegant method is not exploited to calculate the effect of such things as side streams, double feeds, open-steam heating, and for catastrophies such as leaking condensers and steam coils. While it is admitted that extensions such as these are designed for the education rather than the technical training of the student, it is worth remembering that the whole purpose of education at university level is to condition the student so that he may behave correctly in new and unexpected surroundings.

In general, however, the range and adequacy of treatment compel admiration. In the reviewer's opinion, one more section should have been added, namely, a discussion on the thermodynamic efficiency of the various processes considered. At a time when the supply of fuel and power is becoming more and more important, many traditional processes are being re-evaluated in the light of comparison with a thermodynamically-ideal process. The student profits a great deal by making such a survey. The authors introduced the subject of thermodynamic irreversibility in the first volume; it is a pity they did not develop its application in the second.

THE AMERICAN APPROACH TO PRESTRESSED CONCRETE

Design of Prestressed Concrete Structures. By T. Y. LIN. *John Wiley and Sons, Incorporated, 440 Fourth-avenue, New York 16, N.Y., U.S.A.* (11.50 dols.); and *Chapman and Hall, Limited, 37 Essex-street, London, W.C.2.* (92*s.*)

Although engineers in the United States were among the first to realise the value of prestressing in structural engineering, as is shown by the patents issued at the end of the Nineteenth Century and the early years of this century, practical application of the methods, except to circular tanks and pipes, made little headway there until about the year 1950. Two years later, however, no less than 100 structures had been completed. The initial lack of interest is difficult to explain but was probably due to a belief that construction in prestressed concrete was too costly in labour and of little economic value, except where the saving of steel was of considerable importance as it was in Europe. There is, even to-day, a considerable difference between the two continents in regard to the relative importance of the costs of labour and materials in structural design. The European designer has generally been interested in refinements of design which save materials, while the American engineer is more concerned with mechanical methods of construction which reduce labour costs. It is, of course, problematical whether the use of prestressed concrete would have become so widespread in the United Kingdom so quickly had the shortage of steel not made its adoption inevitable in many cases. Certainly it was not that American engineers were unable to appreciate the technical advantages to be had, for prestressing of the walls of circular tanks had been carried out by means of turnbuckles and by mechanical methods of wire-winding for very many years, and there were also several methods in use for the mass production of pressure pipes circumferentially prestressed.

It is apparent from Professor Lin's book that constructional methods differ but little from European practice, but this is not surprising, for many of the bridges and buildings have been designed to use one or other of the patented methods popular in this country. There are, however, two systems which up to now are peculiar to the U.S. One is the stranded-wire cable, generally comprising seven wires and available in sizes allowing a working strength of from 3,000 lb. to 200,000 lb. These cables are anchored in a manner similar to that employed for the rope suspenders of suspension bridges. The other system employs ¼ in. diameter wires at the ends of which "rivet heads" are formed to anchor the wires against steel bearing plates. A somewhat similar system is now being used in Switzerland.

Professor Lin also reports that some American contractors have experimented successfully in the use of lightweight concrete. One of the major limitations of the use of pre-cast concrete, whether normally reinforced or prestressed, is its weight, and in many cases the difficulty of handling heavy members precludes their use entirely. Concrete weighing about 100 lb. per cubic foot, obtained by using an aggregate such as expanded clay or shale, may well enable members of considerably longer spans than hitherto to be used. The density of concrete and its crushing strength are closely related, and lightweight concretes often have a greater shrinkage on setting than normal concretes, so that the proportioning of the mixture has to be carefully controlled; nevertheless, the use of such concrete is certainly worth consideration in this country. What is required, however, before this can be done, is a widely available and economically priced lightweight aggregate.

A typically American development to which the author devotes some pages is the "lift-slab" technique, first used with normally reinforced concrete and now largely employing prestressed concrete. In this system the floors of a building are cast one on top of another, at ground level, separated by paper or by a wax emulsion sprayed on a hardened slab before the succeeding

slab is cast. In this manner there is considerable saving in formwork and in the costs of placing concrete. The previously erected steel columns pass through steel collars embedded in the slabs, and the slabs are raised by various mechanical methods to their correct positions, when the collars are welded to the columns. The floors are designed in a manner similar to that employed for "mushroom" floors or flat slabs. As far as is known, this method of construction has not been used outside the American continent.

Methods of design described by Professor Lin are similar to those commonly employed in this country, and the book can confidently be recommended for its clarity of presentation. Some designers might prefer to obtain initially the sizes of a member from the modulus of section determined from the bending moment and the allowable stresses, as is done for most structural materials, rather than in the way given. The calculation of local stresses near the anchoring devices at the ends of beams is treated rather sketchily, as are also the effects of shrinkage and creep of *in situ* concrete placed to act in conjunction with pre-cast members in composite construction. But with these exceptions it is difficult to see how the book, addressed primarily to students and civil engineers generally rather than to specialists, could have been improved. Consideration is given to partial prestressing and to the use of non-prestressed reinforcement; continuous beams are treated by the principle of moment-areas and by moment-distribution. A brief description of ultimate-load design is based on the methods due to Whitney, and the selection of suitable load factors is discussed. Resistance to fire and corrosion, fatigue strength and the effects of dynamic loads are dealt with in the last chapter, and some useful appendices give data relating to several systems of prestressing together with the criteria for the design of prestressed-concrete highway bridges published by the U.S. Bureau of Public Roads. It is an excellent text-book for the student and a reference book to be recommended for the office.

GOOD PRACTICE FOR THE STUDENT

Worked Examples in Engineering Thermodynamics. By H. J. SMITH and J. W. HARRIS. *Macdonald and Company (Publishers), Limited*, 16 *Maddox-street, London, W.*1. (35*s.*)

The texts of, and solutions to, 321 problems in engineering thermodynamics are contained in this comprehensive collection. The questions have been extracted from a wide range of examination papers set by the University of London, by the Institution of Mechanical Engineers, by various technical education unions and from those proposed for Higher National Diplomas and Certificates and at the Brighton Technical College, where the authors teach.

Though the questions are not dated, they include representatives of practically all topics in applied heat and thermodynamics about which examiners seek to extract information from candidates and upon which they form their conclusions concerning the capabilities of candidates. As long as examination syllabuses remain unchanged the questions set almost inevitably tend to repeat themselves.

Careful study of standard text-books is, of course, the first essential but this, in itself, is not sufficient. Real mastery of any subject, and more particularly of such a subject as thermodynamics, can only be acquired by working out the problems to be found in past examination papers, and considerable practice is required to enable this working out to be completed within a prescribed time. As the authors rightly point out, "model solutions are only of value after the student has obtained his own solution." The solutions are therefore placed separate from the questions.

The solutions are intended to be those which an examiner might reasonably expect in the time allowed for the questions, though the methods used are intentionally not developed to the extent of precluding all necessity for mental exertion on the part of the student. Theory other than that specifically demanded by the question is not given and occasional special references are included in a few of the solutions. The symbols listed at the outset conform, as far as possible, with those now accepted as standard and most of the calculations have been carried out with the slide rule. No misprints were found in checking the working of sample solutions picked at random, but on page x, T^3 F. should read T^3 R, and on page 27 Bernoulli is given as Bernouilli.

When the student, on comparing his solution with that of the authors, finds that his definitions and descriptions, the layout of his working, the illustrative diagrams he has drawn and the final result of his calculations approach theirs in concision, clarity, completeness and correctness he will have good cause to congratulate himself upon his progress.

AN EXTREMELY COMPLEX PROBLEM OF FLIGHT

An Introduction to the Theory of Aeroelasticity. By Y. C. FUNG. *John Wiley and Sons, Incorporated*, 440 *Fourth-avenue, New York* 16, *N.Y., U.S.A.* (10.50 dols.); and *Chapman and Hall, Limited*, 37 *Essex-street, London, W.C.*2. (84*s.*)

Aeroelasticity is a relatively new branch of aeronautical science, although aeroelastic phenomena have been significant since the first aircraft were flown. Thus, as the author of this new treatise observes, "The unfortunate failure of Professor S. P. Langley's famous monoplane in 1903 shortly before the Wright brothers' successful flight, could probably be attributed to wing divergence."

Divergence, a torsional instability due to the increase of aerodynamic moment with increasing twist of a lifting surface, is one of the simpler instances of aeroelastic effects and one of the first to be understood and anticipated in design. On the other hand, flutter, a vibrational instability, was so far from being mastered as recently as 1938 that, in another accident mentioned by the author, a four-engined plane crashed, killing all scientists aboard, in a carefully planned flight-flutter test.

In some branches of applied science, it is the rule rather than the exception for practice to be led by theory, but in the development of aeroelasticity, theory has more often than not been led and stimulated by accident. The reason for this order of action and consequence is not to be found in any deficiency of research effort, in quantity or quality, since the study of aeroelasticity has attracted the interest and energy of many of the outstanding scientists of the period. The explanation is that the problem of flight is one of extreme complexity: control by human touch and perception of a non-rigid structure, on the brink of instability, in a medium not yet fully explored. This is perhaps why, before the publication of this volume, there has been no standard work on aeroelasticity comparable with the classic text-books in the related fields of elasticity, fluid mechanics and aerodynamics. Such a book was becoming overdue, and the editors of the Galcit series of aeronautical texts, as well as Dr. Fung, take credit for its publication.

The book opens with a chapter on "preliminaries," a restatement of the bare elements of elasticity, aerodynamics, mechanics, and analysis, that are necessary for the author's purpose. Unlike some writers who keep strictly to the straight and narrow path of analytical truth, the author does not disdain to point out some of the traps that lie open by the wayside. This method of developing a theme, though a little unorthodox by rigidly pedantic standards, must commend the book to the student who wants to read it without a tutor at his elbow.

Successive chapters cover divergence, aileron reversal and related problems, flutter and flutter analysis. Proceeding to transient loads, gusts and power spectra, and buffeting, the author introduces the necessary mathematical concepts now generally known as operational methods, including the Dirac unit-impulse function, the Duhamel integrals and the Laplace transformation, and he gives a concise introduction to probability theory. These excursions into mathematics arise, however, rather as *aide-mémoires* than as digressions and do not obscure the dominant theme. In the last few chapters, which include a useful summary of the algebra of functional operators, some special problems are discussed in more detail.

The references, approaching 1,000 in all, are arranged under subject sub-headings at the end of each chapter and include titles as recent as 1954. Although some of the references are to standard texts on basic science or analysis, the great majority are to specialised technical papers in the field. Since there is so much relevant material that is only included by reference, the book is properly called an introduction to the theory. In spite of this qualification it is comprehensive without being superficial, and it is likely to be as welcome and indispensable to the practitioner of aircraft design as it will be to the student.

THE FOREMAN'S WORRIES

How Foremen Can Control Costs. By PHIL CARROLL. *McGraw-Hill Book Company, Incorporated*, 330 *West* 42*nd-street, New York* 36, *N.Y., U.S.A.* (4 dols.); and *McGraw-Hill Publishing Company, Limited*, 95 *Farringdon-street, London, E.C.*4. (30*s.*)

For all the growth of staff and specialist jobs, the foreman, by whatever name he is known, remains in most industries the final link in the management chain on whom the tempo and quality of work depend.

It has been increasingly recognised in recent years that the training and status of the average foreman are to-day below what the job requires. Courses of various types are therefore being given for him both within firms and in technical and adult colleges. The movement has gone even further in the United States and a large number of books and magazines are published to help foremen improve their knowledge.

This book is mainly a series of articles published in one of these magazines, *Supervision*, and written in the typical American matey-humorous style which is supposed to make difficult stuff palatable to those who have done little reading since they left school. Nevertheless it does set out, not unsuccessfully, to show in simple terms what are the items which comprise the costs of production, why they are important and what can be done to reduce them. The chapters cover in their breezy way descriptions of the functions of cost accountants, time and motion study men and progress chasers and attempt to make the reader feel some understanding, and even sympathy, for their apparently interfering and unproductive functions. The essence of these chapters is the help which the staff members can give to foremen who discuss their problems with them. Other chapters deal with reduction of idle time and of scrap, the problem of "rush" jobs, and "specials," the nature of overhead costs, suggestions from employees, methods of dealing with grumbles, and machine maintenance.

Perhaps the most surprising thing to a reader in this country is to find that the problems discussed are mainly those that would arise, not in the mass production shop thought to be typical of American industry, but in the jobbing shop in which each job is dictated by the whims of the customer as interpreted by the salesman, and in which the foreman has a wide general responsibility.

If this little book were a quarter of its price and were translated into a colloquial style more suited to this country, it would make a useful addition to the handbooks on the shelf in any foreman's office.

NEW BOOKS

Some of the books noticed here are selected for extended review in ENGINEERING.

Preventive Maintenance of Electrical Equipment. By CHARLES I. HUBERT. *McGraw-Hill Book Company, Incorporated*, 330 *West* 42*nd-street, New York* 36, *N.Y., U.S.A.* (4 dols.); and *McGraw-Hill Publishing Company, Limited*, 95 *Farringdon-street, London, E.C.*4. (30*s.*)

The purpose of this book is to describe up-to-date methods for the preventive maintenance of electrical apparatus, to provide logical methods by which the more common troubles may be identified and localised, and to recommend emergency repairs which will keep the equipment in operation. It is divided into three sections the first of which details the preventive maintenance methods suitable for motors, generators, transformers, switchgear and electronic apparatus. The second deals with the methods more fully with particular emphasis on emergency repairs, and the third shows how maintenance methods can be improved by the use of the correct operation techniques.

Diecasting Die Design. By H. K. BARTON and L. C. BARTON. *The Machinery Publishing Company, Limited, National House, West-street, Brighton*, 1. (17*s.* 6*d.*)

This volume of 158 pages has recently been added to *Machinery's* "Standard Reference Series." It is intended for practising diecasters and also for buyers and designers of die castings, and deals with the operational aspects of die design for diecasting. The various chapters deal with such matters as runners and gates, ejector mechanisms, fixed cores and die inserts, retractable cores, the location of casting inserts in the die, insert pre-loading devices, magazine feeds and the use of loose die inserts. Other sections discuss thermal balance in the die, operational factors affecting cavity disposition, and the design of dies for ease of maintenance and finishing, and for dimensional accuracy. Numerous clear line drawings are included.

Function and Training of the Chemical Engineer. Project No. 297. *Organisation for European Economic Co-operation*, 2 *Rue André-Pascal, Paris* 16, *France*. (430 francs.); and *H.M. Stationery Office, Kingsway, London, W.C.*2. (8*s.* 6*d.*)

This is a report of an international conference held in London from March 21 to 23, 1955. The conference comprised six sessions under the following headings: "The part played by the chemical engineer in bridging the gap between research and plant construction"; "The chemical engineer in plant operation and management"; "Model courses of study for a primary degree in chemical engineering"; "Other educational schemes in chemical engineering"; "The practical training of the chemical engineer before and after entry into industry"; and "Chemical engineering research: its future needs and scope." The report includes the opening address to the conference by the Marquess of Salisbury, and a summing-up by the chairman, Sir Harold Hartley.

Column Tests on some Proposed Aluminium Standard Structural Sections. By R. E. SMITH. Research Report No. 28. *The Aluminium Development Association*, 33 *Grosvenor-street, London, W.*1. (7*s.* 6*d.*)

The only standard aluminium structural sections available in Great Britain are those specified in B.S. 1161 : 1951, *Aluminium and Aluminium Alloy Sections*. In 1952, the Aluminium Development Association began an investigation of some new standard sections which would make more effective use of the advantages of the extrusion process. All the proposed sections incorporated root fillets and edge beads to provide resistance to elastic instability, and as no theoretical work was readily available for these types of section it was considered advisable to check the load-carrying capacity by test. The present report describes the tests as applied to the following sections: light and medium equal-bulb angles; unequal-bulb angles; light and medium lipped channels; lipped H-sections. The results are discussed and conclusions drawn concerning the data now recommended for use as a basis of design.

Buyer's Guide to European Machinery: Classified List of Engineering Trade Associations in Western Europe. *Organisation for European Economic Co-operation*, 2 *Rue André-Pascal, Paris* 16, *France*. (180 francs); and *H.M. Stationery Office, Kingsway, London, W.C.*2. (3*s.* 6*d.*)

Until 1952, the O.E.E.C. issued a booklet at regular intervals giving information on export availabilities and delivery periods for all types of machinery and equipment. This publication was then suspended in view of the changed situation with regard to engineering industries, and the O.E.E.C. decided to issue a list of the associations of manufacturers of engineering equipment in Member countries, based on information supplied by the governments concerned. These voluntary trade associations do not necessarily include all the manufacturers of a particular type of equipment; they do not act as commercial agents, but are able to provide buyers with impartial information as to delivery possibilities for those categories of equipment which fall within their province. Section I consists of tables giving, opposite each category of equipment, the reference numbers of the appropriate associations in the various countries, as listed in the second part. Section II shows the associations classified according to countries, each with its address, reference number and an indication of the equipment it covers.

Handbook of the Collection Illustrating Time Measurement. Part II: Descriptive Catalogue. By A. B. WARD. Third edition. *Science Museum, South Kensington, London, S.W.*7, and *H.M. Stationery Office, Kingsway, London, W.C.*2. (6*s.*)

This is the third edition of the Catalogue and brings the record of the exhibits up to date. More than 460 items are listed as well as some that are not normally on show. The types range from an early Egyptian shadow clock to the most modern examples of time recorders driven by electricity.

Switching Relay Design. By R. L. PEEK, JR., and H. N. WAGAR. *D. Van Nostrand Company, Incorporated*, 250 *Fourth-avenue, New York* 3, *N.Y., U.S.A.* (9.50 dols); and *Macmillan and Company, Limited, St. Martin's-street, London, W.C.*2. (70*s.*)

Switching relays are used in a wide variety of computing devices, automatic control apparatus and telegraph and telephone systems. To facilitate their development Bell Telephone Laboratories have carried out training courses in their design for a number of years and the present book has been prepared from the texts prepared for these courses. It deals with fundamental mechanical and electromagnetic requirements and with the magnetic details that affect the design.

Automobile Electrical Equipment. By A. P. YOUNG and L. GRIFFITHS. Fifth edition. Published for "Automobile Engineer" by *Iliffe and Sons, Limited, Dorset House, Stamford-street, London, S.E.*1. (25*s.*)

This is the fifth edition of a book which was first published in 1933. It covers the fundamental principles underlying the design of each piece of equipment, followed by practical details illustrated by diagrams and photographs. The present edition has been revised to include details of flashing-light direction indicators, electrical control for overdrive systems, electrically operated door gear, lighting systems for motor cycles and other recent developments.

Machine Translation of Languages. Fourteen Essays. Edited by WILLIAM N. LOCKE and A. DONALD BOOTH. Published jointly by the *Technology Press of the Massachusetts Institute of Technology* and *John Wiley and Sons, Incorporated*, 440 *Fourth-avenue, New York* 16, *N.Y., U.S.A.* (6 dols.); and *Chapman and Hall, Limited*, 37 *Essex-street, London, W.C.*2. (48*s.*) (Reviewed on page 136, in the issue of February 10.)

Chemical Engineering. Vol. II: Unit Operations. By J. M. COULSON and J. F. RICHARDSON. *Pergamon Press, Limited*, 4-5 *Fitzroy-square, London, S.W.*1. (60*s.*) (Reviewed on page 180.)

Design of Prestressed Concrete Structures. By T. Y. LIN. *John Wiley and Sons, Incorporated*, 440 *Fourth-avenue, New York* 16, *N.Y., U.S.A.* (11.50 dols.); and *Chapman and Hall, Limited*, 37 *Essex-street, London, W.C.*2. (92*s.*) (Reviewed on page 180.)

Worked Examples in Engineering Thermodynamics. By H. J. SMITH and J. W. HARRIS. *Macdonald and Company (Publishers), Limited*, 16 *Maddox-street, London, W.*1. (35*s.*) (Reviewed on page 181.)

How Foremen Can Control Costs. By PHIL CARROLL. *McGraw-Hill Book Company, Incorporated*, 330 *West* 42*nd-street, New York* 36, *N.Y., U.S.A.* (4 dols.); and *McGraw-Hill Publishing Company, Limited*, 95 *Farringdon-street, London, E.C.*4. (30*s.*). (Reviewed on page 181.)

An Introduction to the Theory of Aeroelasticity. By Y. C. FUNG. *John Wiley and Sons, Incorporated*, 440 *Fourth-avenue, New York* 16, *N.Y., U.S.A.* (10.50 dols.); and *Chapman and Hall, Limited*, 37 *Essex-street, London, W.C.*2. (84*s.*) (Reviewed on page 181.)

TRADE PUBLICATIONS

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Castings for Dies, Plungers and Moulds. DARWINS LTD., Tinsley, Sheffield, 9. The Tru-process method of producing castings by an investment technique employing a high-grade refractory material which will resist the attack of steels and other special alloys of high melting point. It is used for the production of dies and moulds for the die-casting of non-ferrous metals, for moulds for plastics and glass, and for the making of castings for other industries. Illustrated brochure.

Road-Building Equipment. BLAW-KNOX COMPANY, Export Department, 405 Lexington-avenue, New York 17, N.Y., U.SA. "Complete-package" of heavy road-building equipment, including batching plant, sub-grader, paver, formwork, vibrators and finishers. New machines are the Road Widener, the Trench Roller, and the Base Paver. Illustrated catalogue, No. 2502; editions available in English, French, Spanish and Portuguese.

Expanded Metal. EXPANDED METAL CO. LTD., Burwood House, Caxton-street, Westminster, London, S.W.1. Flattened "Expamet" and safe-mesh "Expamet." Applications include ceiling panels, balustrades and machinery guards, as well as domestic uses. Tables of mesh sizes and wire gauges, properties and other data. Booklet entitled "Expanded Metal in Industry".

Flexible Rubber Latex Moulds for Casting. THE BRITISH RUBBER DEVELOPMENT BOARD, Market Buildings, Mark-lane, London, E.C.3. Concise instructions for three methods of preparing flexible moulds of rubber latex for casting, from a plaster master, replicas in such materials as cold-setting resins, alabaster and plaster of Paris. Illustrated "Broadsheet No. 5."

Technical Bulletins. VACUUM OIL CO. LTD., Caxton House, Westminster, London, S.W.1. Technical Bulletins on waxes, oils and greases. No. 1, s/v Ceremuls (wax emulsions); No. 2, Petrolatums (jellies); No. 3, Ball and roller bearing lubrication; No. 4, Enclosed gear lubrication; No. 5, Machine shop oils; No. 6, Open gear lubrication.

Aluminium Casting Alloys. ALAR LTD., 3 Albemarle-street, London, W.1. Aluminium casting alloys for general engineering purposes, their related specifications and trade names, minimum mechanical properties, chemical composition, physical and general properties and casting characteristics. Revised edition of wall data sheet.

Mobil Industrial Review. MOBIL OIL CO., LTD., Caxton House, Westminster, London, S.W.1. The first number of a quarterly review to be published in this country and abroad. In this issue there are articles on Dr. Diesel, and the engine that bears his name, its principle, advantages, manufacture and lubrication.

Mobile Cranes. STEELS ENGINEERING PRODUCTS, LTD., Crown Works, Sunderland. Coles cranes for road or rail. Petrol or Diesel-electric drive with capacities ranging from 3 to 20 tons. Also grabs and dogs to suit. Particular reference to the needs of the iron and steel industry. Illustrated catalogue.

Production Facilities. S. E. OPPERMAN, LTD., Boreham Wood, Hertfordshire. Specialist manufacture of engineering equipment. A list of the plant at present available is given in an illustrated brochure, with some examples of the very wide range of products made by the firm.

Signal Lamp Fitting. LONDEX, LTD., Anerley Works, 207 Anerley-road, London, S.E.20. Signal lamp fitting with single hole fixing. Lens domed for all-round vision; available in several colours. Seven-watt size lamp. Illustrated list No. 142/A.

Fused Connector-box. M. K. ELECTRIC LTD., Wakefield-street, Edmonton, London, N.18. Fused connector-box, with earthing facilities, for plaster-depth mounting. Suitable for clocks, etc.; fuse rating 1 amp. Leaflet.

Road Shelters. GEORGE PIKE LTD., Alma-street, Birmingham, 6. Portable road shelters; steel tubing frame with covers of green proofed jute or flax, or proofed cotton duck. Dimensions and prices. Leaflet.

Spheroidal-Graphite Iron Castings. ARMSTRONG WHITWORTH (METAL INDUSTRIES) LTD., Close Works, Gateshead-upon-Tyne, 8. Properties, characteristics and typical applications of spheroidal-graphite iron castings. Illustrated leaflet.

Waste-Water Meter. GEORGE KENT, LIMITED, Luton. Description of gate-type waste-water meter, with some notes on waste detection. Illustrated pamphlet No. 968/1155.

LUBRICATING WIRE ROPES

OIL DELIVERED UNDER PRESSURE BY SELF-CONTAINED UNIT

A machine for cleaning and lubricating wire ropes has recently been designed and patented by Cable Lubricators Limited, 93 Hope-street, Glasgow, C.2. Known as the "Universal Auto Cable Lubricator," it is independent of external services and effects positive cleaning and thorough inter-strand lubrication from surface to core. It consists of a split casing and rotor so that it may easily be mounted round a wire rope, and is illustrated in the drawing below. Integral with the manganese-bronze main rotor, in which are incorporated special pre-formed hydraulic seals, is a positive displacement pump rotor. This in combination with the pump volute in the spheroidal-graphite cast-iron casing delivers a volume of lubricating oil under sufficient pressure for it to penetrate through the interstices between the wires to the core of the rope. Fitted to the machine is a hydraulic pressure gauge and re-set counter, which record lubricating-oil pressure and length of wire rope treated.

The drive consists of a rope-motor of novel design which is directly coupled to the inlet of the main rotor. This mechanism comprises spring-loaded radial mounted driving members, which are actuated by their bearing surfaces being in contact with the helical strand formation of the wire rope. The passage of the wire rope through this floating mechanism produces automatic rotation of the rope-motor which drives the lubricator rotor at the specified speeds, thereby delivering under pressure the requisite volume of oil to the rope. Mounted on the inlet side of the rope-motor are radial cleaning fingers which are secured to the floating driving members, and effectively clean the wire rope prior to its entry into the motor and pressurised oil chamber of the lubricator.

FOR ROPES OF CHANGING DIAMETER

Owing to the spring-loaded devices, the driving members and cleaning fingers are capable of outward radial travel, thereby permitting automatic flotation to take place in the event of variation from the normal wire-rope diameter. Similarly, the pressurised oil chamber hydraulic seals embodied in the main rotor are so designed and resiliently mounted that they are also capable of automatic radial float, and will function effectively notwithstanding the variations from the nominal diameter of the wire rope being treated. The presence of broken wires in a rope will not affect the efficiency of the equipment, owing to the floating properties of all vital component parts in direct contact with the rope.

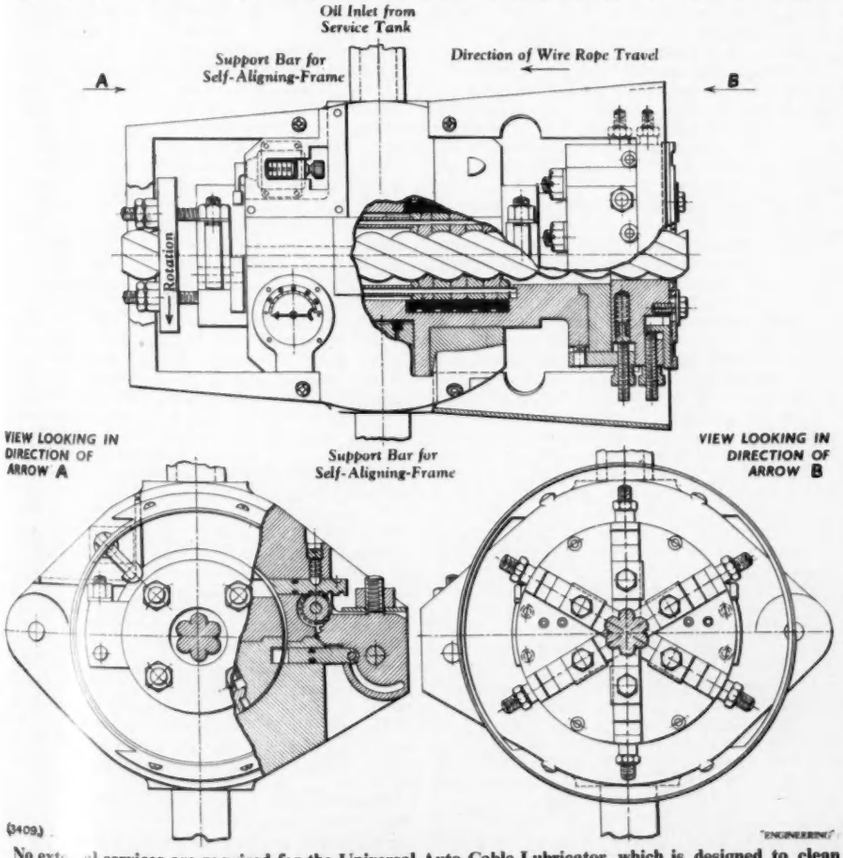
Since the equipment is of split-casing design, an automatic rotor-casing locking mechanism is incorporated, which accurately locates each half of the rotor in the corresponding half of the casing when the machine is in the open position prior to inserting the wire rope. Immediately the machine is fitted and closed round the rope, and the main hinge bolt swung into position, the mechanism automatically disengages from the rotor halves.

In order to fit the machine to a wire rope of round-strand or flattened-strand construction, it is only necessary to fit the appropriate size of hydraulic-seal assembly unit into the main rotor and pre-set the driving members of the rope-motor by means of a simple gauge to correspond to the wire-rope root diameter; the driving member stops are then locked in position so preventing further inward travel and eliminating the possibility of excessive pressure being applied to the surface wires and strands of the wire rope.

The equipment is made in four sizes: model No. 1 ranges in rope capacity from $\frac{7}{16}$ in. to $\frac{11}{16}$ in. diameter inclusive; No. 2 from $\frac{3}{4}$ in. to $1\frac{1}{8}$ in.; No. 3 from $1\frac{1}{2}$ in. to $1\frac{7}{8}$ in.; and No. 4 from $1\frac{7}{8}$ in. to $2\frac{1}{4}$ in.

For general haulage and winding applications it is recommended that the equipment be located in a frictionless self-aligning mounting frame in order to maintain automatically accurate co-axial alignment of the machine with the moving wire rope. A lubricating-oil service tank of either five or ten gallons capacity mounted on an adjustable stand is provided to serve the equipment in horizontal, vertical and inclined operating positions.

It should be noted that internal corrosion ultimately produces corrosion fatigue, and this is believed to constitute 70 per cent. of all wire-rope failures. This hazard can be largely reduced by use of the lubricator; not only does it extend the life of wire ropes but it maintains them in flexible condition. The makers claim in addition that consumption of wire-rope lubricant is extremely economical.



No external services are required for the Universal Auto Cable Lubricator, which is designed to clean and lubricate wire ropes. Oil is supplied under pressure to give thorough penetration, and a split casing enables the unit to be easily mounted.

★ ★ ★

STUD WELDING IN CONFINED SPACES

An attachment for the Nelson stud welding tool has been developed by Crompton Parkinson, Limited, Crompton House, Aldwych, London, W.C.2, which enables studs to be welded at right-angles to the tool. It therefore facilitates the equipment's use in confined spaces.

The attachment takes the place of the tool's standard chuck and leg assemblies, and is designed for easy fitting by the three screws which are normally used to hold the adjustable leg bracket in position. The attachment can be fitted to the tool at any angle relative to the tool hand grip, thereby further facilitating the equipment's use. Apart from this, operation of the tool is exactly the same as with the standard arrangement. A patented fluxed stud is inserted in the chuck; a porcelain ferrule—the purpose of which is to prevent oxidation of the weld metal—is held round the end of the stud; and then with the now loaded tool pressed sideways against the workpiece, the trigger button is depressed and the weld automatically completed.

★ ★ ★

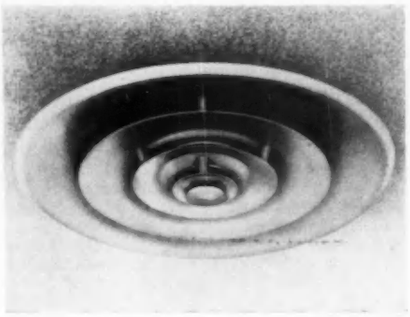
WIRE-ROPE TERMINAL

A terminal for wire ropes has been produced by the Tulloch Construction Company, Limited, 70 Brighton-road, Sutton, Surrey, which consists of three parts and can be attached in a few moments. The three parts are the terminal itself, which has a hollow screwed body, a taper plug which fits inside the body and spreads the strands of the rope, and a sleeve which threads on the rope and is screwed into the body to clamp the strands. The resulting termination is said to exceed the strength of the rope used.

★ ★ ★

GRAPHITE LUBRICATION

A graphite-based lubricant is now being marketed by Jenograph Limited, a recently-formed firm of the Jenolite group, 13-17 Rathbone-street, London, W.1. This lubricant, which is known by the same name as the company, contains pure natural graphite, the average particle size of which is 0·4 micron, and the maximum less than 1 micron. The small particle size allows the lubricant to enter the hollows of even a very smooth surface and provide a bearing face. It also prevents sludging. Jenograph can be used alone or mixed with other oils and greases.



The volume of ventilation air passing through the diffuser can be controlled by a series of sliding sleeves operated by the central knob.

VENTILATION AIR DIFFUSER

Disc Unit with Volume Control

An improved model of their air diffuser, the Stylovent, has been introduced by Richard Crittall and Company, Limited, 151 Great Portland-street, London, W.1. It retains the performance of the original model, but has been changed in appearance and incorporates a volume control system. Several sizes are available and all of them can be supplied for exposed or flush mounting. Their object is to disperse large volumes of air evenly throughout a room. They can be also used as extractors.

As will be seen from the accompanying illustration, the diffuser embodies in its design a throat piece to which is attached a number of annular plates of decreasing diameter. A coned skirt is affixed to the outer perimeter of each plate, and the plates are spaced to provide the desired air distribution. The volume control mechanism consists of a number of sleeves also of diminishing diameter, corresponding with the throat piece and the annular plates, and interconnected by a bearer bar that can be raised or lowered by means of a threaded spindle actuated by a knob at the bottom of the unit.

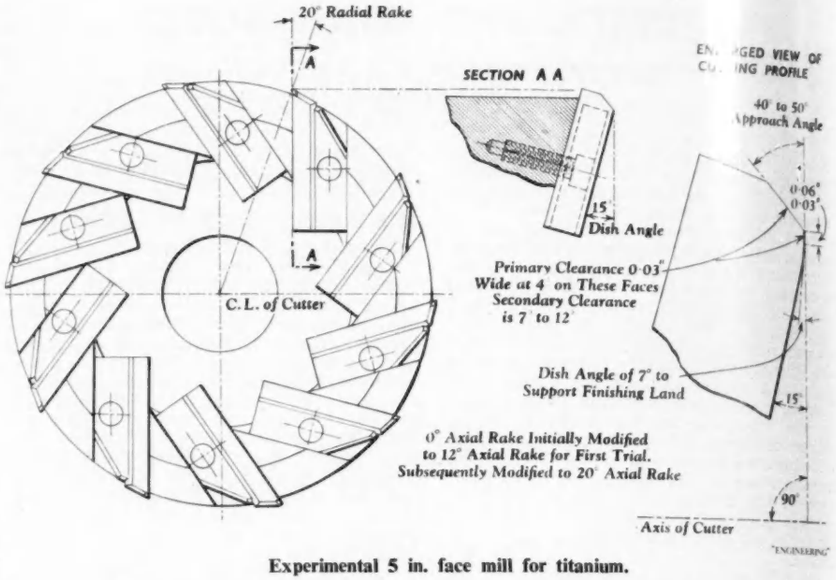
The sleeves thus form splitter vanes sliding inside the throat piece. On actuation of the operating knob, the sleeves, or splitter vanes, are moved to open or close the apertures between the annular plates, so effecting the desired volume control. To provide cut-off and ensure smooth operation of the volumetric control, cushioning felt is fitted to the sliding surface of the main sleeve. The entire assembly, including the operating gear, can be removed as one unit. This feature facilitates fitting of the assembly to ducting concealed in false ceilings, etc. It also provides easy accessibility for cleaning.

★ ★ ★

THE SCOPE OF WORK STUDY

British Productivity Council Films

Three work-study films in the series " Better Ways " have recently been released by the British Productivity Council, 21 Tothill-street, London, S.W.1. The first, entitled " Introducting Work Study," shows how work study fits into the national economy and stresses its application not only to manufacturing industry but also to transport, distribution, agriculture and wherever work is done. The second film, " The Whole Works," depicts work study not merely as a technique but as a complete approach to increased efficiency and demonstrates how the performance of a factory making a wide range of products in small batches of various sizes was improved. "All Over the Shop " indicates the ways in which work study can yield other benefits than greater output. It reveals how a chronic shortage of skilled men was relieved in an electronics firm and how processes were improved in a pharmaceutical works and a hosiery factory. The films, which have been made by the B.P.C. with the co-operation of the European Productivity Agency and will be distributed throughout Europe, are designed not to teach work study but to arouse interest in the subject. Inquiries should be made to the Council's Visual Aids Officer.



Experimental 5 in. face mill for titanium.

FACE-MILLING OF TITANIUM

TWO COMPANIES ATTACK MACHINING PROBLEM

The introduction of titanium and its alloys has presented many machining problems, and much still remains to be discovered about the subject in general. One problem, that of face-milling of titanium, has been investigated jointly by William Jessop and Sons, Limited, Sheffield, and Short Brothers and Harland, Limited, Belfast. As a result, face-milling cutter designs and techniques have been developed which have proved very encouraging.

The experimental work was done on work-pieces of titanium 150A, which had been hot rolled by William Jessop and Sons. This material work-hardens during manipulation. Hardness of the material after machining varied between 356 and 400 V.P.N. The cutter used was a modification of a 5 in. diameter face mill of Jessop design, having inserted blades of Cutanit carbide. Mechanical clamps were used to hold the blades in place, and the mounting and clamping were such that various combinations of cutting angle could easily be ground on the ends of the blades. A tough grade of Cutanit carbide was chosen, for mechanical strength at the cutting point, and the blades contained no titanium carbide. The latter is undesirable when machining titanium, as it appears that chips from the workpiece have a chemical affinity for carbides containing mixed crystals of tungsten and titanium carbide, and wear and chemical attrition on the rake face are heavy.

In the design of the cutter, illustrated above, a radial rake of 20 deg. was adopted, and the original axial rake of zero was modified to 12 deg. positive at the time of the initial tests. For the second set of tests it was increased to 20 deg. The approach angle was maintained at 40 to 50 deg. throughout the trials, as the sole application was face-milling. Further investigations being planned may involve approach angles which will make the cutter suitable for working close to a shoulder. In order to obtain a good finish a land between 0·06 in. and 0·03 in. wide was ground on the bottom of the tooth form, care being taken to maintain the land at 90 deg. to the axis of the cutter. A dish angle of 7 deg. provided support and backing for this land. Primary clearance was 0·03 in. at 4 deg. Secondary clearance was 7 deg. to 12 deg.

The slender sections used in aircraft work will deflect under the load imposed by heavy cuts, and local distortions may occur as a result of the poor thermal conductivity of titanium 150A. The cutter was therefore made with a large number of teeth, to maintain light tooth loads, and to minimise shock loading and spindle oscillation as the teeth entered and left the workpiece. It was found advantageous to use machine tools with infinitely-variable table feeds, as the tooth loads could be reduced as the cutter entered and left the workpiece. For the best results the machine must be heavy and rigid.

During its first run on a Kendall and Gent vertical milling machine the cutter removed 15 cub. in. of material from a number of small titanium components, the speed being 125 ft. per minute, with a depth of cut of between 0·125 in. and 0·175 in. Feed was 0·002 in. to 0·003 in. per tooth or 2·5 in per minute. The cutter was deliberately tested until the cutting edges had been destroyed. Risk of fire is considerable when taking finishing cuts on this material, and increases as the cutting edge deteriorates. No fire occurred, however, in this case, sparking was not excessive, and heating of tool and workpiece appeared to be small.

The cutter was then modified, and machining to a tolerance of 0·002 in. was carried out with ease. Surface finishes were 25 to 30 micro-inches in this and succeeding tests. Various combinations of speed, feed and depth of cut were tried. Typical performance figures were; 250 ft. per minute at a feed of 10 in. per minute (0·005 in. per tooth). Depth of cut was 0·025 in. to 0·05 in. The cutter removed 20 cub. in. of metal, and the wear land, which was remarkably uniform on all the blades, was about 0·015 in. At this stage the cutter was re-serviced while waiting for further supplies of material, and in preparation for more experiments. In the normal course of events it appears probable that a total of about 40 cub. in. of metal could have been removed before the cutter needed re-servicing.

Heavier cuts were taken, but there was insufficient material to enable the life of the cutter to be ascertained. Typical roughing conditions were speed 125 ft. per minute, at 0·15 in. depth of cut and 7½ in. per minute feed (0·0035 in. per tooth). Surface finish was in the region of 80 to 120 micro-inches.

The information on which this article is based was prepared by Mr. L. Fine, carbide development engineer of William Jessop and Sons, Limited, and Mr. F. Menelaus, tool development engineer of Short Brothers and Harland, Limited.

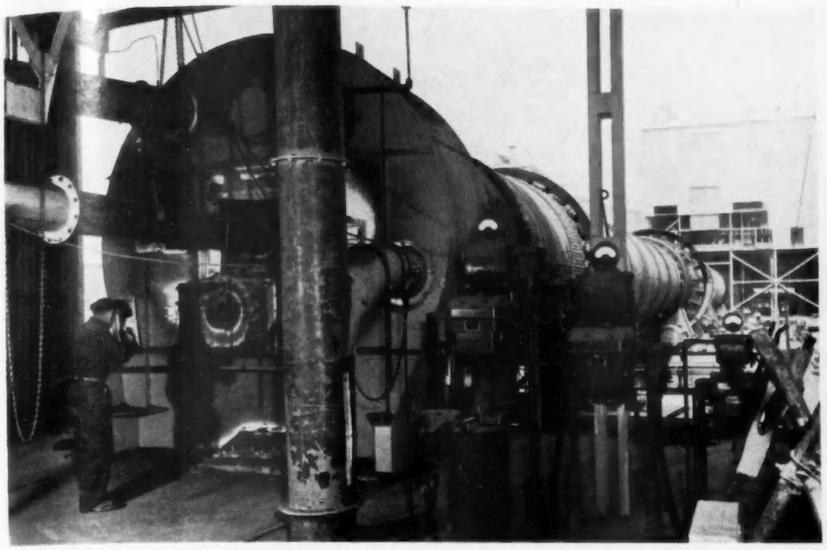


Fig. 1 One of the 230 ft. kilns at Whitehaven in which sulphur dioxide and cement clinker are produced. Operating temperatures may be as high as 1,600 deg. C.

SULPHURIC ACID AND CEMENT PRODUCTION

A DUAL-PURPOSE FACTORY IN CUMBERLAND

During the last 20 years the world's consumption of sulphuric acid has been rapidly increasing, the principal raw material used in its manufacture in Great Britain originally being elemental sulphur which was imported from the United States. By 1951, however, domestic requirements were absorbing 88 per cent. of the total sulphur production of that country. Imports to the United Kingdom were reduced by one-third so that rationing had to be applied, priority of supply being given to essential trades. The possibility of using the anhydrite occurring in large quantities in various parts of the north of England was considered, and borings at Whitehaven, made by Marchon Products, Limited, confirmed the existence of large seams of this mineral under their chemical factory. It was consequently decided to form a subsidiary company—Solway Chemicals, Limited—to manufacture sulphuric acid and also cement which is a co-product of the anhydrite process, the output of the former being about 90,000 tons per annum, of which about half was to be used in the Marchon works.

This plant, which has now been in operation for over six months, obtains its anhydrite from a mine some 300 ft. below ground, access to which is obtained through two parallel drifts, each 1,000 yards long, and driven to a falling slope of 1 in 7. After the rock has been blasted the resulting loose material is loaded by electric shovels on to Diesel engine-driven dumpers and tipped into a hopper. It is taken thence by conveyor belts to screening and crushing plant on the surface, where it is weighed, screened and crushed to a final size of about ¾ in. It was estimated that the production of anhydrite at Solway would be about 175,000 tons per annum, but this figure has actually been doubled.

CRUSHERS AND KILNS

The crushed anhydrite is mixed with shale and coke and is fed to a ball mill where it is ground to fine powder and pumped to raw meal silos. This part of the plant, with the raw meal silos in the background, is illustrated in Fig. 2. The meal is then analysed and, if necessary, blended to ensure that it contains the correct percentage of constituents for efficient firing. Finally, it is passed to two rotary kilns, each of which is 230 ft. long and 11 ft. 2 in. in diameter and lined to withstand temperatures of up to 1,600 deg. C. One of these kilns, which are supplied by Edgar Allen and Company, Limited, Sheffield, is shown in Fig. 1. Normally, the gas leaving the cold end of each kiln contains about 9 per cent. of sulphur dioxide, while about 140 tons of cement clinker per day is discharged at the other end.

On leaving the kiln the gases are drawn through a standard purifying and cooling system by turbo-blowers and are then successively filtered, cooled and dried prior to being passed over a catalyst with an excess of air so that sulphur trioxide is formed. This sulphur trioxide is next absorbed into circulating sulphuric acid, which is kept at constant strength by the controlled addition of water. The plant is also equipped for the production of oleum. The stripped gas is discharged into the atmosphere through a 200 ft. chimney. The cement clinker, on the other hand, is conveyed from the kiln to the clinker building where it is mixed with gypsum and ground to form cement. It is then automatically bagged ready for dispatch.

The plant in the raw materials handling, acid and cement sections of the factory is all electrically driven, a supply for that purpose being obtained from a double circuit line of the North Western Electricity Board. The incoming voltage of 33 kV is stepped down to 11 kV and fed to a main switchboard of Reyrolle manufacture. From this board a feeder is run to each end of a 0·3 sq. in. ring main to which four substations are connected; and two 0·2 sq. in. feeders are run to a substation in the crushing plant. The cables used for this purpose in the acid section are specially protected to guard against seepage and, like those under roads and railways, are carried in pipes. They were manufactured and installed by Crompton Parkinson, Limited, Aldwych, London, W.C.2.

PRECAUTIONS AGAINST ACID FUMES

The presence of acid fumes also influenced the type of transformer used. All the outdoor units, of which typical examples are shown in Fig. 3, are hermetically sealed and are finished with acid resisting paint. To facilitate interchangeability only two standard sizes were adopted—1,000 kVA, which transform the 11 kV supply to 415 volts, as employed on most machines, and 750 kVA for the 3·3 kV supply used in the mine and in the grinding plant.

The switchgear, which is housed in brick and concrete buildings, has also been standardised. All the high voltage units are of Compton Parkinson's vertical isolation type with oil-filled circuit-breakers and air-insulated busbars suitable for fault levels of 150 MVA, while the 3·3 kV and lower voltage equipment is of the same firm's " Klad " design, except for a number of controls on the ring main where ASA pattern isolators have been employed. The copper busbars and connections are mainly tinned, but are sometimes coated with an anti-acid varnish.

So far, 437 motors of Crompton Parkinson manufacture and ranging in output from 850 h.p. to fractional horse-power have been installed; the hand-operated oil-immersed starters were supplied by Geo. Ellison and Company, Limited, Perry Bar, Birmingham, and the liquid and automatic starters by Allen West and Company, Limited, Brighton.

The motors driving the grinding mills are, however, controlled by solenoids fitted on the 11 kV circuit-breakers and operated by push buttons at the motor. These motors, one of which is shown in Fig. 4, have double squirrel-cage rotors and are so designed as to produce 40 per cent. of their full-load torque with 3½ times the full-load current at starting. The motors driving the Fuller-Kenyon compressors, which

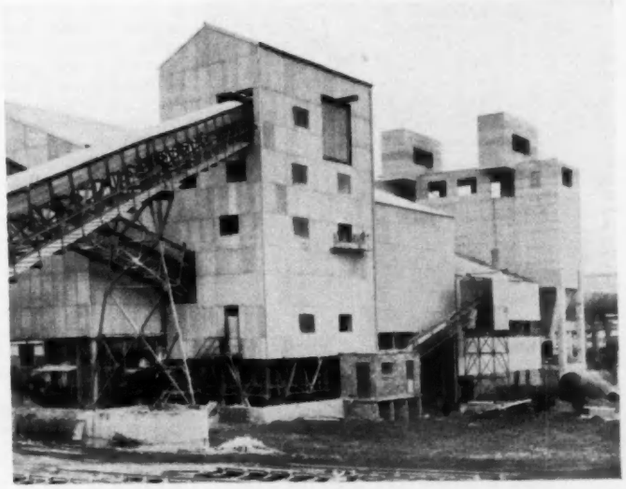


Fig. 2 Anhydrite crushing plant and raw material silos at the sulphuric acid and cement factory of Solway Chemicals Limited, Whitehaven. Use is made of materials mined directly below the works.

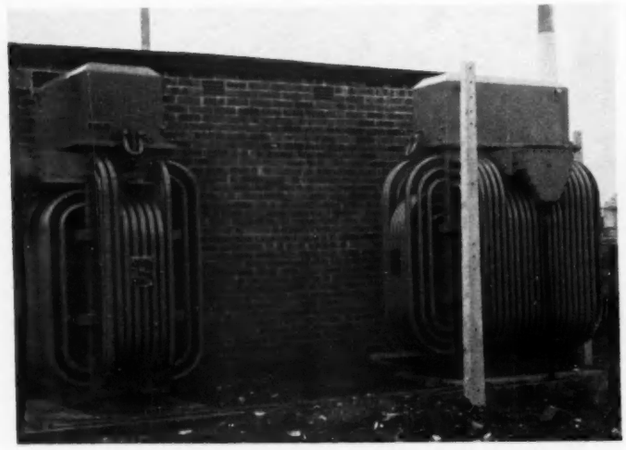


Fig. 3 1,000 kVA, 11 kV/440 volt transformer (on the left) and 750 kVA, 11 kV/3·3 kV transformer (on the right) both hermetically sealed to resist acid fumes.

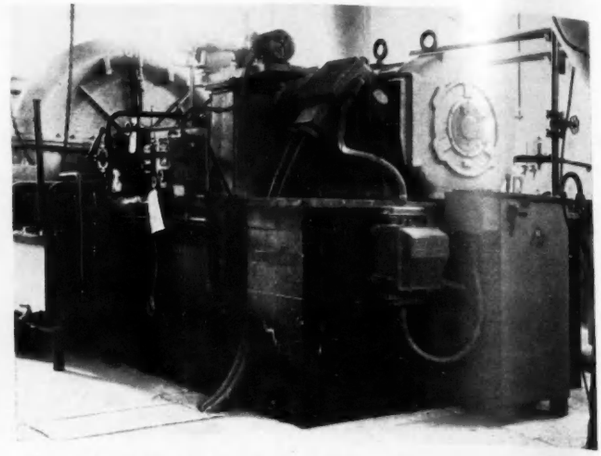


Fig. 4 One of the 400 h.p. motors with a double squirrel-cage rotor designed to produce 40 per cent. full-load torque with 3½ times full-load current at starting. These motors drive the blowers.

pump the finely powdered raw meal and the finished cement into the silos, exert a 250 per cent. full-load torque at starting to cope with full pipes.

In spite of the increase in output from 70,000 tons to 100,000 tons per annum for both acid and cement, records show that the electricity consumption will remain about 20 million kWh per annum with a maximum demand of about 3·75 MW. The load factor is 59·6 per cent. and the average power factor 0·93 lagging.

The main contractors for the plant were the Engineering Division of Marchon Products, Limited, under the direction of Mr. A. Lindsay, while the Electrical Department under the supervision of Mr. H. G. Burton was responsible, with Crompton Parkinson, Limited, for the electrical installation.

THE ENBEECO PROFILE PROJECTOR

Rapid and Accurate Inspection of Small Components

A simple and convenient form of profile projector, known as the Enbeeco Mark III, manufactured by Newbold and Bulford, Limited, Enbeeco House, Roger-street, Grays Inn-road, London, W.C.1, is illustrated on this page. It is designed to project magnified profiles of small mechanisms, or components such as screws, on to a screen which forms an integral part of the instrument and is arranged so that if desired an accurate scale drawing can be made on it to show whether or not the form and dimensions of the object being projected are correct.

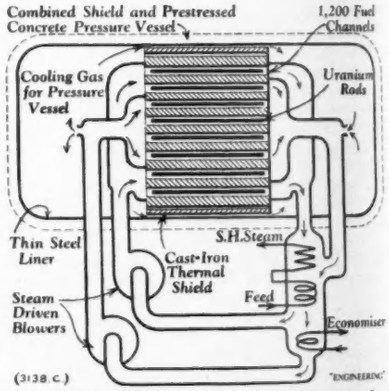
Magnified image of a small gearwheel as thrown on to the screen of the projector.

The cabinet, which is made from ½ in. resin-bonded oak-faced plywood, is 23½ in. high, 10½ in. wide and measures 20 in. from back to front. The viewing screen at the top is slightly inclined to the vertical and has a clear aperture of 8 in. by 7¾ in. It is formed of two sheets of glass between which a sheet of Ethulon plastic tracing film is sandwiched. If an outline diagram is required for comparison purposes it can be drawn on this film. The stage on which the object to be projected is placed measures 5 in. by 4 in. and can be moved longitudinally and transversely by a pair of ½ in. micrometers reading directly to 0·001 in. It is mounted on a tubular pedestal with adjustment for focusing.

The light source is a 100 watt pre-focused projection lamp mounted on the bottom of the cabinet and supplied with direct or alternating current from the mains. A concave silver surface mirror mounted behind the lamp directs the light through an achromatic condenser lens in the front face of the cabinet on to a plane mirror set at an angle of 45 deg. inside the tubular support of the stage. From this mirror the light passes upwards in a parallel beam through an opening in the centre of the stage to the projection lens which is mounted in the bottom of a wedge-shaped metal canopy attached to the front face of the cabinet as shown. Two projection lenses are provided, giving magnifications of 10 and 15 diameters respectively on the screen; they are mounted in a slide so that they can be readily interchanged. The light rays from the projection lens in use are brought to a focus on to the screen by two plane mirrors. The reflecting surfaces of the mirrors are aluminised and provided with a quartz hardened coating to enable them to be cleaned without risk of damage. As its weight is only 28 lb., it is readily portable. Metric micrometers can, of course, be fitted if preferred.

POWER REACTORS

Owing to a misleading translation of the French paper P337 (International Conference on the Peaceful Uses of Atomic Energy, Geneva, August 1955) a false impression of the French power reactor G2 was given in our article "Power Reactor Projects Throughout the World" (ENGINEERING, vol. 180, page 490, 1955). On page 491 (page 2 of the reprint) under paragraph 4, *The French Power Reactor G2*, the third sentence should read: "First, the fuel channels are arranged horizontally in G2, and secondly the carbon-dioxide coolant gas is divided into two main zones of different mean temperatures, the outer zone being the hotter" A revision of the corresponding layout diagram, Fig. 3 (page 492 in the article and page 3 in reprint), together with the revised caption is shown below. It is also necessary to make some minor corrections to Table I (page 490, article; page 1, reprint). In the last line but one, beginning "25 (LMFR)" the four figures for Power Cost should be from left to right: "5·7, 1·4, 0·7 and 7·8." It should be noted that the figure 1·4 represents fuel and blanket processing cost only; fuel inventory is included in fixed charges. In addition, Table II, column 1, item 25 (page 498, article; page 9, reprint), gives the paper number as P493; this should be P494. Finally, on page 491 (reprint: page 2), column 2, immediately above "**A. Gas-Cooled Reactors,**" the American mill should have been given equal to 0·09 d, not 0·9 d. Some reprints of this correcting paragraph will become available in due course. A third reprint of the complete article with revisions will be published shortly.



The French carbon-dioxide cooled G2 reactor has sub-divided gas flow and horizontal fuel channels.

(Fig. 3 in original article)

BRITISH RAILWAY ELECTRIFICATION

BACKGROUND TO FUTURE PROGRAMME

At the beginning of March the British Transport Commission announced that they proposed (subject to the approval of the Minister of Transport) to carry out main line electrification in this country on the high voltage single phase 50 cycle system. This decision was reached as the result of a survey into the relative costs of converting and operating a typical line on the 1,500 volt direct-current and 25 kV 50 cycle systems and the evidence is to be embodied in a report, on which the following notes are based. Comment will be found on page 161.

The line chosen for the survey was the London Midland main route from Euston to Manchester and Liverpool. For both economic and technical reasons power would be drawn direct from the 132 kV grid and for the alternating current system only 12 substations with duplicate single phase transformers would be required. By contrast, to use the 1,500 volt direct-current system on the same route about 70 substations would be necessary, A lengthy 33 kV cable system and about 300 MW of converting plant would also have to be provided. With the alternating current system, on the other hand, it would only be necessary for the Central Electricity Authority to install about 200 MW of transformers. Maintenance charges would be less although the cost of power distribution would be about the same in each case.

TRANSMISSION AND SUPPLY

The alternating current contact system would only weigh one-third of that for direct-current, owing to the reduction in the cross-section of the copper from 0·6 sq. in. to 0·23 sq. in. for equivalent conductivity. A considerable reduction in the strength and cost of the supporting structures would therefore be possible, thus facilitating erection, permitting the work to be more easily mechanised and providing better visibility. In fact, it is found that by employing alternating current for all the lines proposed for electrification in the Modernisation Plan there would be a saving of about 27,000 tons of copper and 16,000 tons of steel.

Substantially larger clearances to ensure safe working would, however, be required between the live wires and earthed structures, and between the contact wire, the locomotives, the rolling-stock and the wagon contents with the alternating-current than with the direct-current system. It is therefore proposed to use a basic minimum clearance of 11 in. for the former as against the 4 in. for the latter. To obtain this 11 in. clearance 701, or 78 per cent. of the total, of the 904 bridges between Euston, Manchester and Liverpool via Birmingham and Crewe would have to be lifted. Where lifting, lowering the track, or reconstruction with shallow girders is impossible, and where tunnels cannot be enlarged or opened out, it is proposed that the line voltage should be reduced from 25 kV to 6·6 kV, at which voltage a minimum clearance of 4 in. would be required.

It is estimated that the capital costs of supplying power for the Euston-Manchester-Liverpool scheme from the 132 kV grid would be £38·6 million for the 1,500 volt direct-current and £29·3 million for the 25 kV alternating-current system. These sums include all the fixed electrical equipment and the provision of the necessary clearances, as well as annual charges to the Central Electricity Authority. In spite of the fact that some lines will present more difficulties than others it is considered that the advantages of the alternating-current system will apply in equal or greater measure to all those sections which are likely to be electrified.

DIRECT-CURRENT MOTORS RETAINED

Discussing the qualities of alternating and direct-current motors it is pointed out in the report that 50 cycle alternating-current motors of the output required can now be constructed. Such motors are, however, more complicated, of larger diameter and more expensive than their direct-current counterparts; and practice on the French Railways is now tending towards methods which do not require their use. The direct-current series motor is therefore to be maintained on British Railways and will be supplied from the alternating-current system through a transformer and either a rectifier or motor-generator.

The French Railway authorities consider alternating-current locomotives, equipped with direct-current motors, to be capable of handling loads 60 per cent. in excess of those permissible with the latest type of direct-current locomotive of the same weight and with a chassis of similar design, so far as adhesive properties are concerned. This will permit the construction of lighter and cheaper locomotives, thus reducing the wear and cost of reconditioning the track. Until the benefits accruing to the alternating-current rectifier locomotive through its adhesive characteristics were recognised it was expected that it would be more expensive than its direct current counterpart and that the additional cost might be a serious offset to the savings on the first cost of fixed equipment obtainable with the alternating-current system. It was, in fact, largely for this reason, states the report, that the 1951 committee* did not regard the system as likely to be attractive financially for British Railways in general.

It is now however considered that there will be little difference between the two systems as far as the total cost of motive power is concerned, for although at present the rectifier locomotive is more expensive this position should change as more experience is gained. This also applies to multiple-unit stock.

The estimated costs of electrifying the Euston-Manchester-Liverpool section on the 25 kV alternating and 1,500 volt direct-current systems are given in the table below:

—	25 kV a.c. £ million	1,500 volt d.c. £ million	Difference in favour of a.c. £ million
Power supply and overhead system (including cost of providing clearances) ..	29·3	38·6	+ 9·3
Motive power	48·6	46·3	− 2·3
Signalling	25·0	24·5	− 0·5
Depots	2·7	2·7	—
Train heating and lighting ..	6·1	7·1	+ 1·0
Contingencies	6·1	4·4	− 1·7
Total, £ million ..	117·8	123·6	+ 5·8

In preparing these figures no account was taken of possible reductions in the costs of motive power as conversion proceeds. The lines under consideration are among those carrying the heaviest traffic on British Railways. The motive power requirements therefore represent a greater proportion of the total cost than would be the case on other lines, so that the case for the alternating-current system is thus presented at a disadvantage. The density of constructional features affecting expenditure on electrical clearances is also higher on these lines than elsewhere.

As regards annual costs it is estimated that maintenance and depreciation would amount to £4·7 million for the alternating-current and £5·2 million for the direct-current system. Power would cost £2·2 million and £2·5 million respectively and interest would account for £4·7 million and £4·9 million. The annual cost of the 25 kV alternating-current system would therefore be £11·6 million as against £12·6 million for 1,500 volt direct current.

While, remarks the report, the 1951 committee recognised the attractive features of the alternating-current system in reducing the cost of fixed installations they feared that the total cost of motive power would render the total outlay on electrification little, if any, lower. They therefore thought that account should be taken of such matters as inter-running between the standard system and the low-voltage system on the Southern Region; the unbalancing effect of a large single-phase load on the three-phase national supply network; interference with railway telecommunications; and the experimental nature, at that time, of the existing 50 cycle systems.

Since 1951 experience has, however, resolved all these points in favour of the alternating-current system with the exception of inter-running. Locomotives capable of operation on both the 25 kV and 660 volt direct-current system could however, be built, if required, and their extra cost would be trifling in comparison with the wider issues at stake.

In fact, taking an overall view the Commission are satisfied that the 50 cycle alternating-current system offers substantial economies both in first and annual costs. They also consider that it will permit the electrification of certain secondary lines, where the use of the direct-current system could not be financially justified. Further, they are convinced that the alternating current system promises much greater potential for development than is the case with other systems.

IMPLEMENTATION OF PLAN

The modernisation plan for British Railways includes the electrification of the main trunk routes from London to Birmingham, Crewe, Liverpool and Manchester; from London to Doncaster, Leeds and (possibly) York; and from London to Ipswich, including the Clacton, Harwich and Felixstowe branches, a total of 820 route miles. It also includes 390 route miles of suburban electrification mainly in the London area and 250 route miles of lines to the Kent coast in the Southern Region.

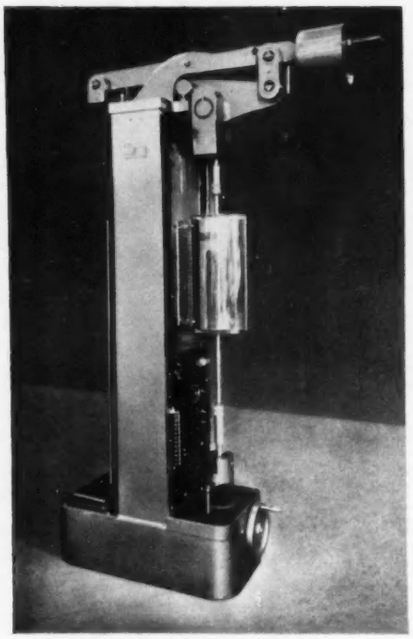
All these lines, except those in the Southern Region, will be electrified on the 50 cycle single-phase-alternating current system. The electrification of the line from Manchester to Crewe will be carried out as the first stage, since it can be completed quickly and will enable experience to be gained. Meanwhile work on the other schemes will be conducted as rapidly as the availability of staff and material will allow.

As regards the effect of the selection of the alternating-current system on existing and authorised electrification schemes the Liverpool-Southport, Wirral and Tyneside lines do not present pressing problems, as they are isolated from those forming part of the modernisation plan. The Euston-Watford line is another separate entity, while the Manchester-Altrincham line and Manchester-Sheffield-Wath line need not be changed at present, although it may be necessary to undertake their conversion later to secure full inter-running.

It has been decided that the existing direct-current system will continue to be used in the Southern Region with the reservation that alternating current might be introduced in the western section. Consideration is also being given to converting the Manchester-Bury line to alternating current at 6·6 kV, as the cost of obtaining clearances for 25 kV under the numerous overbridges would not be warranted. After careful thought it has been decided to convert the existing 1,500 volt direct-current line from Liverpool Street to Shenfield and its extensions to Chelmsford and Southend to alternating current, a voltage of 6·6 kV being employed in the inner areas so as to reduce the additional civil engineering work to a minimum. It has also been decided to equip the London, Tilbury and Southen line and the Enfield and Chingford lines on the alternating-current system. This will lead to economies as other lines in East Anglia are electrified and will ensure full inter-running between all lines north of the Thames.

When the electrification of the Glasgow suburban lines is effected the alternating-current system will also be adopted using a voltage of 6·6 kV in the inner zone and 25 kV in the outer areas.

* See ENGINEERING, vol. 171, page 386 (1951).



The Baldwin creep-testing machine can be used, with different sub-assemblies, for long-time creep tests, creep-rupture tests, relaxation tests, and constant strain-rate tests.

20,000 LB. CREEP-TESTING MACHINE

Interchangeable Sub-Assemblies

A new versatile creep-testing machine of 20,000 lb. capacity developed by Baldwin-Lima-Hamilton Corporation, Philadelphia, 42, Pennsylvania, U.S.A., can be used both for long-time creep tests, the load being applied and measured by weights on a lever arm, and for creep-rupture tests. The same basic creep machine with different components can also be used for relaxation tests and constant strain-rate tests.

With the lever-arm loading system, a motor-driven loading screw maintains the lever in a horizontal position during creep of the test specimen. The weights are thus lifted only a fraction of an inch so that fracture of the specimen will produce only a little shock. A 40-to-1 lever system permits loading to the rated capacity with 500 lb. of weights.

Creep-rupture tests have been greatly improved by the use of a more accurate Microformer-controlled weighing system in place of the lever-arm unit. The motor-driven screw already mentioned serves as the loading mechanism.

The machine is built on a large base so that no foundation bolts are required and the enclosed cushion mounts are equipped with levelling screws. An improved furnace provides for tests up to 1800 deg. F. It is of the tubular type, 16 in. long, and has a thermocouple for heat measurement and control. Creep measurements can be made inside the furnace by means of an optional extensometer attached to the specimen over a 3½ in. gauge length. It has a range of 2 in. Alternatively, movement of the loading screw measures the specimen elongation when the extensometer is not used. The elongation is indicated by a counter in increments of 0·000025 inch.

A strip-chart recorder for time/elongation curves can be used with the machine, taking creep measurements from either the extensometer or the loading-screw pick-up. The accuracy of the loading systems is within 1 per cent. of applied load or 0·2 per cent. of capacity, whichever is greater.

NOTICES OF MEETINGS

Aslib

LONDON
"Industrial Research for Small Firms, with Special Reference to the Role of Information Services," by C. N. Kington. Royal Society of Arts, John Adam-street, W.C.2. Fri., April 13, 6 p.m.*

British Institution of Radio Engineers

GLASGOW
"Glasgow University Synchrotron." Visit and discussion. Scottish Section. Department of Natural Philosophy, The University, Glasgow. Wed., April 11, 7 p.m.
LIVERPOOL
Annual General Meeting and Film Evening. Merseyside Section. Chamber of Commerce, 1 Old Hall-street, Liverpool, 3. Wed., April 11, 7 p.m.
NEWCASTLE-UPON-TYNE
Annual General Meeting. North-Eastern Section. Neville Hall, Westgate-road, Newcastle-upon-Tyne. Wed., April 11, 7 p.m.

British Interplanetary Society

LONDON
Annual General Meeting (Members only). Caxton Hall, Victoria-street, S.W.1. Sat., April 21, 6 p.m.
BIRMINGHAM
"Astronautics To-day," by R. B. Beard. Midlands Branch. Regent House, St. Phillips-place, Colmore-row, Birmingham, 3. Sat., April 14, 6.30 p.m.

British Nuclear Energy Conference

LONDON
"The Control, Conveyance, Treatment and Disposal of Radioactive Effluents," by W. L. Wilson, P. A. White and J. G. Milton. Institution of Civil Engineers, Great George-street, S.W.1. Thurs., April 12, 5.30 p.m.*

Building Centre

LONDON
Films on Manufacture and Use of Paint. Wed., April 11, 12.45 p.m.

Chemical Society

BELFAST
"Adsorption by Porous Solids," by Professor D. H. Everett. Northern Ireland Branch. Queen's University, Belfast. Thurs., April 19, 7.45 p.m.
MANCHESTER
Symposium on "Lubrication." Manchester Branch. The University, Manchester. Thurs., April 19, 10.30 a.m. and 2.30 p.m.
ST. ANDREWS
"A New Chemistry," by Dr. R. N. Haszeldine. St. Andrews and Dundee Branch. St. Salvators College, St. Andrews. Fri., April 13, 5.15 p.m.

Faraday Society

NOTTINGHAM
Discussion on "Membrane Phenomena." Great Hall, The University, Nottingham. Tues., April 10, 2.15 p.m.; Wed., April 11, 9.15 a.m. and 2.15 p.m.; and Thurs., April 12, 9.15 a.m.

Illuminating Engineering Society

BRISTOL
Annual General Meeting and Film Evening. Bath and Bristol Centre. Royal Hotel, Bristol. Fri., April 20, 7 p.m.
LIVERPOOL
Open Discussion. Liverpool Centre. Liverpool Engineering Society, 9 The Temple, 24 Dale-street, Liverpool. Tues., April 17, 6 p.m.
MANCHESTER
Annual General Meeting, 5 p.m. Discussion Evening, 6 p.m. Manchester Centre. Offices of the North Western Electricity Board, Town Hall Extension, Manchester. Thurs., April 19, 6 p.m.

Incorporated Plant Engineers

LONDON
"District Heating Schemes," by W. A. Gregory-Carter. College of Preceptors, Bloomsbury-square, W.C.1. Thurs., April 19, 7 p.m.*
BLACKBURN
"Electronics in Industry," by A. Worland. Blackburn Branch. Golden Lion Hotel, Blackburn. Thurs., April 19, 7.30 p.m.
NOTTINGHAM
"A Personal Approach to the Design of Control Gear," by J. B. Saunders. East Midlands Branch. County Hotel, Theatre-square, Nottingham. Wed., April 18, 7 p.m.
ROCHESTER
"Modern Workshop Techniques," by V. A. Barnes. Kent Branch. Bull Hotel, Rochester. Wed., April 18, 7 p.m.

Institute of British Foundrymen

LONDON
Apprentices' Evening. Programme introduced by A. Talbot. London Branch. Waldorf Hotel, Aldwych, W.C.2. Wed., April 11, 7.30 p.m.
BEDFORD
"Some Foundry Problems," by G. J. Rogers. Bedfordshire and Hertfordshire Section. At works of W. H. Allen, Sons and Co., Ltd., Bedford. Thurs., April 12, 7.30 p.m.
DERBY
Annual General Meeting and Short Paper Competition. East Midlands Branch. College of Arts, Derby. Sat., April 14, 5.30 p.m.
MANCHESTER
Annual General Meeting. "Some Experiences with the CO_2 Process," with film, by R. E. Spencer. Lancashire Branch. Midland Hotel, Manchester. Sat., April 14, 3 p.m.
NEWCASTLE-UPON-TYNE
Annual General Meeting and Film Evening. Newcastle Branch. Neville Hall, Westgate-road, Newcastle-upon-Tyne. Sat., April 14, 6 p.m.
THORNABY-ON-TEES
Annual General Meeting and reading of prize-winning paper. Tees-Side Branch. At works of Head, Wrightson and Co., Ltd., Teesdale Hall, Thornaby-on-Tees. Fri., April 13, 7.30 p.m.

Institute of Fuel

LONDON
Annual Corporate Meeting. Institution of Civil Engineers, Great George-street, S.W.1. Wed., April 18, 5.30 p.m.*

Institute of Metals

LONDON
May Lecture on "Ferroelectrics," by Dr. Willis Jackson. Royal Institution, Albemarle-street, W.1. Tues., April 10, 7 p.m.
Spring Meeting. Alternative Sessions at Church House, Great Smith-street, S.W.1. Wed., April 11, 10 a.m. and 2.30 p.m.; and Thurs., April 12, 10 a.m. and 2.30 p.m.
Conversazione and Exhibition of Materials Employed in Nuclear-Energy Engineering. 4 Grosvenor-gardens, S.W.1. Thurs., April 12, 7.30 p.m.
Spring Meeting. Concluding Session: Discussionon "Alloy Thermodynamics." Institution of Naval Architects, 10 Upper Belgrave-street, S.W.1. Fri., April 13, 10 a.m.
"Electron Emission from Metals," by Professor Erich Schmid. Institution of Naval Architects, 10 Upper Belgrave-street S.W.1. Fri., April 13, 2.30 p.m.

Institute of Petroleum

LONDON
"The Oil Industry: Its Place in the World and Its Future," by J. W. Platt. Wed., April 11, 5.30 p.m.*

Institute of Welding

LONDON
Annual General Meeting and Discussion. North London Branch. British Welding Research Association, 29 Park-crescent, W.1. Thurs., April 12, 7.30 p.m.*
Annual General Meeting at 6 p.m. Film Evening at 7 p.m.* South London Branch. 2 Savoy-hill, W.C.2. Thurs., April 12.
BIRMINGHAM
Annual General Meeting and Film Evening. Birmingham Branch. Grand Hotel, Birmingham. Fri., April 20, 7.30 p.m.

Institution of Chemical Engineers

LEEDS
"Commissioning a Major Coal-Preparation Plant," by A. J. C. Older. North Western Branch. The University, Leeds. Wed., April 11, 7 p.m.
MANCHESTER
"Grinding of Quartz-Limestone Mixtures," by S. W. F. Patching and J. A. Holmes. North Western Branch. College of Technology, Manchester. Sat., April 14, 3 p.m.

Institution of Civil Engineers

LONDON
"Design of Road Intersections," by Kenneth Summerfield. Road Division. Tues., April 10, 5.30 p.m.*
"Glen Shira Hydro-Electric Project," by John Paton. Tues., April 17, 5.30 p.m.*

The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated. Particulars for this column should reach the Editor not later than Monday morning in the week preceding the date of the meeting.

* An asterisk is placed where it is understood that tea is available prior to the time stated.

Aslib (Association of Special Libraries and Information Bureaux), 4 Palace-gate, London, W.8. (WEStern 6321.)
British Institution of Radio Engineers, 9 Bedford-square, London, W.C.1. (MUSeum 1901.)
British Interplanetary Society, 12 Bessborough-gardens, London, S.W.1.
British Nuclear Energy Conference, Great George-street, London, S.W.1. (WHItehall 4577.)
Building Centre, 26 Store-street, London, W.C.1. (MUSeum 5400.)
Chemical Society, Burlington House, Piccadilly, London, W.1. (REGent 0675.)
Faraday Society, 6 Gray's Inn-square, London, W.C.1. (CHAncery 8101.)
Illuminating Engineering Society, 32 Victoria-street, London, S.W.1. (ABBey 5215.)
Incorporated Plant Engineers, 48 Drury-lane, Solihull, Birmingham. (Solihull 3021.)
Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, 3. (Blackfriars 6178.)
Institute of Fuel, 18 Devonshire-street, Portland-place, London, W.1. (LANgham 7124.)
Institute of Metals, 4 Grosvenor-gardens, London, S.W.1. (SLOane 6233.)
Institute of Petroleum, Manson House, 26 Portland-place, London, W.1. (LANgham 2250.)
Institute of Welding, 2 Buckingham Palace-gardens, London, S.W.1. (SLOane 9851.)
Institution of Chemical Engineers, 56 Victoria-street, London, S.W.1. (VICtoria 6161.)
Institution of Civil Engineers, Great George-street, London, S.W.1. (WHItehall 4577.)
Institution of Electrical Engineers, Savoy-place, Victoria-embankment, London, W.C.2. (TEMple Bar 7676.)
Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank-crescent, Glasgow, C.2. (Central 5181.)
Institution of Heating and Ventilating Engineers, 49 Cadogan-square, London, S.W.1. (SLOane 3158.)
Institution of Locomotive Engineers, 28 Victoria-street, London, S.W.1. (ABBey 6672.)
Institution of Mechanical Engineers, 1 Birdcage-walk, St. James's Park, London, S.W.1. (WHItehall 7476.)
Institution of Mining and Metallurgy, 44 Portland-place, London, W.1. (LANgham 3802.)
Institution of Production Engineers, 10 Chesterfield-street, London, W.1. (GROsvenor 5254.)
Institution of Railway Signal Engineers, Euston House, Eversholt-street, London, N.W.1.
Institution of Structural Engineers, 11 Upper Belgrave-street, London, S.W.1. (SLOane 7128.)
Institution of Water Engineers, Parliament Mansions, Abbey Orchard-street, London, S.W.1. (ABBey 6740.)
Junior Institution of Engineers, Pepys House, 14 Rochester-row, London, S.W.1. (VICtoria 0786.)
Royal Aeronautical Society, 4 Hamilton-place, London, W.1. (GROsvenor 3515.)
Royal Meteorological Society, 49 Cromwell-road, South Kensington, London, S.W.7. (KENsington 0750.)
Royal Society of Arts, John Adam-street, Adelphi, London, W.C.2. (TRAfalgar 2366.)
Scientific Film Association, 164 Shaftesbury-avenue, London, W.1. (TEMple Bar 6189.)
Society of Chemical Industry, 56 Victoria-street, London, S.W.1. (VICtoria 5215.)
Society of Instrument Technology, 184 Sherwood Park-road, Mitcham, Surrey. (POLlards 3620.)
Women's Engineering Society, 25 Foubert's-place, London, W.1. (GERrard 5212.)

BIRMINGHAM
"Motorways," by J. E. Jones. Midlands Association. James Watt Memorial Institute, Great Charles-street, Birmingham. Thurs., April 12, 6 p.m.*
MANCHESTER
"Observations on Public-Health Engineering in the United States," by Professor R. J. Cornish. North Western Association. Engineers' Club, Albert-square, Manchester. Thurs., April 12, 6.30 p.m.

Institution of Electrical Engineers

ABERDEEN
"Highland Water Power," by the late T. Lawrie. North Scotland Sub-Centre. Caledonian Hotel, Aberdeen. Wed., April 11, 7.30 p.m.
DUNDEE
"Highland Water Power," by the late T. Lawrie. North Scotland Sub-Centre. Queen's College, Dundee. Thurs., April 12, 7 p.m.
PORTSMOUTH
Annual General Meeting. Discussion on "Soldered Joints," opened by W. Ford. Southern Centre. College of Technology Extension, Anglesea-road, Portsmouth. Wed., April 11, 6.30 p.m.

Institution of Engineers and Shipbuilders in Scotland

GLASGOW
Annual General Meeting. "Mechanisation in Fishing Vessels," by W. Lochridge. Tues., April 10, 6.30 p.m.

Institution of Heating and Ventilating Engineers

BIRMINGHAM
Annual General Meeting. "Some Solutions to Heating and Ventilating Problems in Atomic Energy Research Establishments," by G. M. Harbert. Birmingham Branch. Birmingham Exchange and Engineering Centre, Stephenson-place, Birmingham, 2. Thurs., April 12, 6.30 p.m.
MANCHESTER
"Small Pipe Forced-Circulation Central Heating," by Dr. S. A. Burke and D. V. Brook. Manchester Branch. Engineers' Club, Albert-square, Manchester. Fri., April 13, 6.30 p.m.

Institution of Locomotive Engineers

LONDON
"Evolution of the Internal-Combustion Locomotive," by J. M. Doherty. Institution of Mechanical Engineers, 1 Birdcage-walk, St. James's Park, S.W.1. Wed., April 11, 5.30 p.m.*

Institution of Mechanical Engineers

LONDON
"Fatigue under Triaxial Stress: Development of a Testing Machine and Preliminary Results," by Professor J. L. M. Morrison, B. Crossland and J. S. C. Parry; and "The Fatigue Strength of Specimens Containing Cracks," by N. E. Frost and C. E. Phillips. Applied Mechanics Group. Fri., April 13, 5.30 p.m.*
CHESTERFIELD
"Fatigue of Metals," by Professor J. A. Pope. Joint Meeting of East Midlands and Yorkshire Branches. Technical College, Chesterfield. Wed., April 11, 7.30 p.m.
LEEDS
"Copying Devices and Tracer-Controlled Machine Tools," by H. C. Towne. Yorkshire Branch. The University, Leeds. Thurs., April 12, 7.30 p.m.

Institution of Mining and Metallurgy

LONDON
"Copper and Silver in Silicate Slags," by Dr. F. D. Richardson and J. C. Billington; and "Underground Mining in the Frodingham Ironstone," by A. Alec Jones. Geological Society, Burlington House, W.1. Thurs., April 19, 5 p.m.*

Institution of Production Engineers

CHATHAM
Annual General Meeting and Film Evening. Rochester Section. Sun Hotel, Chatham. Thurs., April 12, 7.30 p.m.
SWANSEA
"Human Relationships and Prpduction," by R. D. Young. West Wales Section. Central Library, Alexandra-road, Swansea. Fri., April 13, 7.30 p.m.

Institution of Railway Signal Engineers

YORK
Annual General Meeting. British Railways Signal School, Toft Green, York. Wed., April 11, 5.30 p.m.*

Institution of Structural Engineers

LONDON
"Road Bridges in Norway," by Arnulf Arild. Thurs., April 12, 6 p.m.*

Institution of Water Engineers

LONDON
Annual General Meeting. "Water Treatment in the Tropics," by E. Field Reid. Institution of Civil Engineers, Great George-street, S.W.1. Thurs., April 19, 2.30 p.m.

Junior Institution of Engineers

LONDON
"Steam Turbine Principles and the Characteristics of Various Types," by P. A. Frowley. Fri., April 13, 7 p.m.*

Royal Aeronautical Society

LONDON
"Investigation of Aircraft Accidents," by E. L. Ripley. Tues., April 17, 7 p.m.

Royal Meteorological Society

LONDON
"Polar Aurora," by J. Paton. Symons Memorial Lecture. Wed., April 11, 5 p.m.*

Royal Society of Arts

LONDON
"The Work of the Colonial Development Corporation," by H. Nutcombe Hume. Thurs., April 12, 5.15 p.m.*

Scientific Film Association

LONDON
Discussion on "Films in the Popularisation of Science." Institut Français, Queensbury-place, South Kensington, S.W.7. Tues., April 17, 6.30 p.m.

Society of Chemical Industry

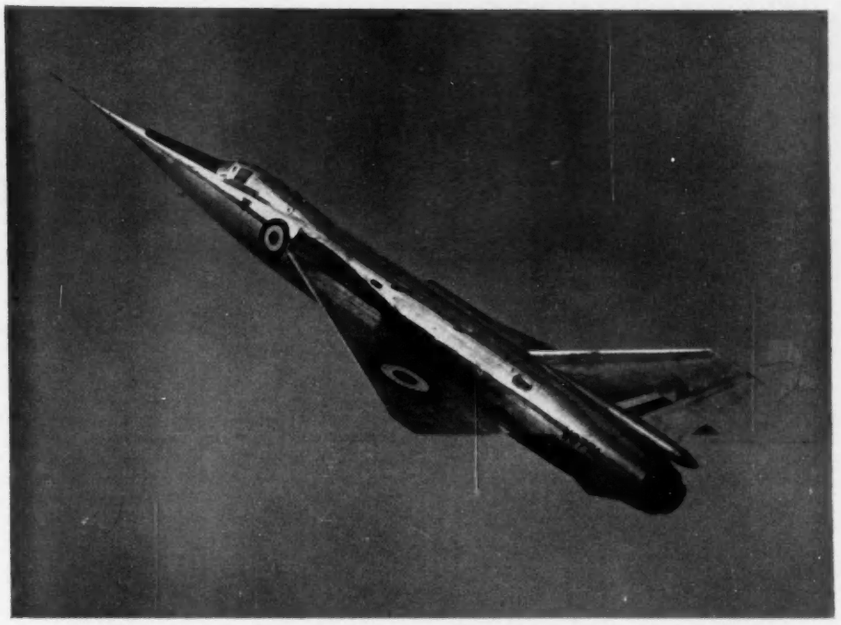
BIRMINGHAM
Symposium on "Corrosion Prevention in Packaging and Storage." The University, Edgbaston, Birmingham. Wed., April 11, 2.30 p.m. and Thurs., April 12, 9.15 a.m.

Society of Instrument Technology

BIRMINGHAM
Annual General Meeting and Address by the Society's President, A. J. Young. Midland Section. Regent House, St. Paul's-place, Birmingham, 3. Fri., April 13, 7 p.m.

Women's Engineering Society

LONDON
"Historical Development of the Blast Furnace in Britain (B.C. to Towards)," by Dr. J. R. Schubert. Hope House, 45 Crawford Peter-street, S.W.1. Tues., April 17, 7 p.m.*



The Fairey Delta 2 aircraft which recently raised the world air speed record to 1,822 kilometres per hour (1,132 m.p.h.); the previous record, 1,323 kilometres per hour (822 m.p.h.) was set up by a North American F.100 Super Sabre last August.

AERONAUTICS DURING THE LAST SEVEN WEEKS

During the past weeks when the publication of ENGINEERING has been suspended by the printing dispute, the outstanding event in aviation was the recapture of the world air speed record for Great Britain by Mr. Peter Twiss in the Fairey Delta 2 research aircraft, powered by a Rolls-Royce Avon turbojet, at a speed of 1,822 kilometres per hour (1,132 m.p.h.); and the margin by which the previous record of 1,323 kilometres per hour was beaten surely constitutes a new kind of record in itself.

THE SPEED RECORD

By travelling at 1,132 m.p.h. Mr. Twiss is not, as stated by some of the daily Press, "the fastest man in the world," for the Bell XIA rocket-powered research aircraft has reached 1,650 m.p.h. in piloted level flight—but not under the carefully controlled conditions of the record flight which preclude the build-up of speed by diving. The F.A.I. rules for the speed record require that two runs be made in opposite directions over a course of length between 15 and 25 km. at any altitude; but once having selected the altitude, it must be maintained within −100 m. over the course and its approaches and must not be exceeded by more than 750 m. during the whole of the record flight; and the margin of error of the speed determination must not exceed 0·25 per cent.

The height selected for the record attempt was 38,000 ft.—a good height for the formation of contrails—and the actual course flown by the Fairey Delta was 9 miles long between Chichester and Ford, Sussex; it was surveyed to within ±0·012 per cent. accuracy by the Ordnance Survey. The entry and exit of the aircraft over its course were recorded by vertical cameras, constructed and operated by the Royal Aircraft Establishment, located in timing huts at each end of the course. It is interesting to realise that, although radar was used for tracking the aircraft for the purpose of control and for briefing the camera operators, it was not considered feasible to trigger the cameras and the quartz-controlled electronic timing mechanism by radar tracking. Instead, as the aircraft entered the straight approach and the afterburner was turned on, the contrails were picked up by tracking telescopes operated manually by visual observers at each timing hut. As each telescope was swung into the vertical plane, the corresponding camera shutter was fired and the timing mechanism was triggered. The operation called for a good deal of skill—as did also the pilot's task of keeping within the specified height limitations.

Since there is a considerable variation of altimeter position error with forward speed, it was necessary before the record attempt to calibrate the aircraft altimeter at the appropriate altitude over a wide range of speed; this was done by closing with a calibrated Venom aircraft, which set the height standard, at a range of speeds up to Mach 1·75 (the Venom's speed being about Mach 0·75). The actual recording of the altitude at which the record flight was made was by means of two sealed Hussenot recorders connected into the aircraft altimeter system.

COMMERCIAL DEVELOPMENTS

Turning from speed records to commercial aviation, the principal event to be recorded is the resignation of Sir Miles Thomas from British Overseas Airways Corporation—the third high-level resignation from the national airways corporation within the last few months. Whereas the other two—Mr. Whitney Straight from B.O.A.C. and Mr. Peter Masefield from B.E.A.—have been attracted to important positions within the aircraft industry, Sir Miles has transferred his interests to the chemical industry. It appears that the nationalised corporations are not offering the scope for action or the financial opportunities to hold men of initiative.

The visit of the Russian twin-jet transport TU104 bringing General Serov to London has attracted great public interest, and a variety of pronouncements on its potentialities—some of them rather discourteously disparaging. Generally it seems to be agreed that it is probably a prototype military transport—and as such would hardly be expected to conform to the standards of a fully operational commercial air liner; that it has a close relationship to the Badger bomber;

that the thrust developed by each engine is of the order of 15,000 lb. and that it probably cruises at about 500 m.p.h. Those who saw it land at London Airport were impressed with its short run. Whatever the virtues of this particular machine, the Minister of Supply, Mr. Reginald Maudling, foresees in Russia a serious contender for the world air-liner markets.

Other news in commercial aviation includes the sale of the 300th Vickers Viscount air liner; the departure of a Britannia propeller-turbine air liner on a demonstration tour in Europe; and the ordering by K.L.M. Royal Dutch Airlines of 12 Lockheed Electra turbo-propeller air liners—the first European order to be placed for Electras, and a disappointment for Vickers-Armstrongs, Limited, who had hoped to see Vanguards on K.L.M's continental services.

SUPER SABRES AND VICTORS

In the military sphere, North American Aviation announced at the end of February that the first 12 F.100 Super Sabre supersonic interceptors had departed for service with the United States Air Force in Europe. Westland Aircraft, Limited, Yeovil, have announced that they are to construct a helicopter, to be known as the Wessex, based on the Sikorsky S.58, but powered by a British gas turbine, the Napier Gazelle. The Wessex is envisaged for anti-submarine and military transport duties. The production of Britain's Victor bombers will be expedited by the opening of a new assembly building at Handley Page's Radlett aerodrome, 675 ft. long, 31 ft. high with an unobstructed width of 150 ft., easily accommodating five Victor aircraft.

REDUCING DRAG BY SUCTION

On the occasion of the opening ceremony of their new assembly hall, Handley Page, Limited, also showed for the first time a laminar-flow research aircraft that has been test flying since 1953. These investigations are intended to explore the reduction in cruising drag which may be expected from the elimination of turbulence in the boundary layer. The aircraft, a two-seat Vampire trainer, has a 5 ft. test-section known as a " glove wing," on the upper surface of its port wing; for symmetry, a dummy glove wing is fitted on the other wing.

The glove wing incorporates 39 span-wise suction strips on its surface, the outer skin being perforated by rows of $\frac{1}{32}$ in. diameter drilled holes. Spanwise ducts below each strip are each connected through a metering orifice to a common suction manifold, through which boundary-layer air is drawn by a turbo-pump (actually a converted Godfrey cold-air unit) driven by air bled from the engine compressor. The total suction applied can be regulated in flight by a valve controlling the compressor tapping, and the distribution of suction can be varied, but not in flight, by changing the sizes of the metering orifices. The amount of suction that has to be applied to maintain laminar flow is small; although the figures for the full-scale test have not been released, we understand that they are of the same order as those quoted by Dr. G. V. Lachmann, in his lecture in 1954 on " Boundary Layer Control," from model tests, in which a suction flow of 0·00027 cub. ft. per second per sq. ft. at the speed of 1 ft. per second was required for laminar flow over 93 per cent. of the chord.

The Handley Page laminar-flow " glove wing " fitted on a Vampire trainer. The thickness of the boundary layer is measured by a traversing Pitot rake which can be shifted chordwise in flight over the wing surface by an electric motor.

The Russian TU104 twin-jet transport at London Airport.

Altitude, speed, suction mass-flow, suction pressures and boundary-layer velocity profiles are recorded on an automatic observer panel in the cockpit. To measure the velocity profiles, Handley Page have developed a travelling Pitot rake, consisting of a series of horizontal flattened hypodermic tubes mounted as a vertical rake, which can be traversed during flight from station to station across the wing chord by a small electric motor. The results obtained are highly promising:—the total drag of the section, in lb. per ft. of span at a speed of 185 knots E.A.S. has been reduced from 3·89, without boundary layer control, to 0·715 with laminar flow—this latter figure including the drag-equivalent of the pump work. No trouble has been experienced in flight from the accretion of foreign bodies, but in the hangar the wing is kept covered to prevent dust building up in the perforations; and during warm weather when flies abound at lower altitude, temporary protection over the leading edge may be used on take off, which is jettisoned at operating height. The next stage will be the flight-testing of an aircraft in which the complete wing is " laminarised."

ENGINE DEVELOPMENT

In the field of engine development, Rolls-Royce, Limited have announced that they are to construct a high-altitude test plant with two test cells for full-scale turbojets and propeller turbines, a Mach 4 wind tunnel, full-scale construction testing facilities and a 15,000 h.p. compressor test rig.

For the coming high-supersonic generation of aircraft, it appears likely that the high-temperature gas turbine will be an essential requirement if useful ranges are to be attained; and the most promising means of achieving higher temperatures appears, at present, to be by air-cooling the blades. The possibilities have been discussed recently in a Royal Aeronautical Society lecture on " The High Temperature Turbojet," given by Mr. D. G. Ainley of the National Gas Turbine Establishment, in which he revealed that an experimental air-cooled turbine has been successfully operated under laboratory conditions at gas temperatures up to 1,400 deg. K. (present-day uncooled engines are operating at turbine inlet temperatures of about 1,150 deg. K.).

Finally, we should mention briefly the Ninth Louis Bleriot Lecture in which the Ministry of Supply's Director of Scientific Research, Mr. E. T. Jones, discussed " A Philosophy of Aeronautical Research." The most significant of the many points he touched upon is, perhaps, the thought that security, by withholding information from the community as a whole, is preventing the community from contributing to the advance of knowledge and that ultimately a " point of no return " must be reached at which the community's ability to defend itself will be seriously weakened.

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PROTECTION AGAINST CORROSION

Fibre-Reinforced Plastics Compound

A fibre-reinforced plastics material known as V.G. Compound, which can be applied by brush on metal surfaces as an effective and economical protection against the corrosive effects of aggressive atmospheres, sea water, hydro-carbon products and a wide range of chemical agents, both in gaseous and liquid form, has been introduced by V.G. (London), Limited, 5-6, Newman Passage, London, W.1.

The material consists of a mixture of a synthetic resin or latex with high-alumina cement, the whole being reinforced with a tough woven fabric. The plastics compound is applied in two layers, interspersed with the woven fabric, to a total thickness of about $\frac{1}{8}$ in. It is cold setting. The weight of the complete coating is approximately 9 lb. per square yard. Little preparatory treatment is required: it is sufficient to remove loose scale and rust by wire brush; the presence of moisture does not impair the effectiveness of the application.

Because of the toughness of the layer produced, V.G. Compound is likely to be particularly applicable for structures composed of thin sheeting, since it will afford them extra strength as well as corrosion protection.

The compound is impermeable and flexible, shows no softening at elevated temperatures and has a good impact strength, comparing favourably in this respect with standard concrete. The adhesion strength is also very satisfactory.

Extensive initial tests have confirmed the applicability of this interesting material in shipyards, and in oil refineries in this country and in France, in gas producing plants and also in sewage treatment works. One department of the Ministry of Works has reported very good results for containers coated with the compound and subjected to the corrosive action of formalin.

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CABLE MARKING SLEEVES

In any complicated electrical installation it is necessary to mark the various leads for identification. Several different types of marker have been produced and one which is said to retain both its colour and its printing is now being made by Creators Limited, Plansel Works, Sheerwater, Woking, Surrey.

Three types are available made in natural rubber, synthetic rubber and polyvinyl chloride, and are marketed under the names of Plantex, Plansyn and Planvin, respectively. These are resistant to acids, alkalis and petroleum fluids, and will stand up to heat and strong light without deterioration. They are produced in a large range of colours and the caption on them can be printed to any desired specification.

In Parliament

PRIVATE ATOMIC ENERGY

Questions and debates in the House of Commons during the past few weeks have ranged over many matters of technical as well as industrial and economic consequence. Some of these problems are referred to elsewhere in these columns. Atomic energy was to the fore on several occasions and an important statement was made by Mr. R. A. Butler, the Lord Privy Seal, on the Government's policy in respect to its development by private industry.

It was considered, he said, that the relationship between the State and private industry in this field should be one of close partnership, subject to the maintenance of a proper degree of Governmental control possibly by the exercise of the powers available under the Atomic Energy and Radioactive Substances Acts, 1946 to 1954. Much of the necessary research, development and production would have to be carried on by the Atomic Energy Authority, if only owing to the high cost of the capital facilities required. Some activities, such as the importation and processing of uranium and the separation of U 235 in the diffusion plant, must remain the responsibilities of the Authority alone, because they concerned defence as well as civil requirements. Where nuclear fuel was required by industry, it would be provided on loan.

The Government hoped that both private and nationalised industry in the United Kingdom, which started late compared with industry in the United States, would enter as rapidly and extensively as possible into the atomic-energy field, in order to develop commercially the civil applications of these discoveries.

ENGINEERS THE LIMITING FACTOR

As examples of the participation of private enterprise in the atomic-energy field, the nuclear power stations to be built for the electricity authorities would be designed and constructed by private industry; and private industry, not the Authority, would fulfil export orders. The Authority were very willing to give industry the maximum assistance which their technical resources permitted, subject to their interests being safeguarded on two points. One of these was that, where appropriate, the Authority should be paid for commercially valuable information, and for the use of patent rights owned by them, which had been acquired at considerable public expense. The other was that firms should not be enabled to use the assistance afforded to them by the Authority to build up exclusive rights for themselves.

In answer to Mr. W. N. Warbey (Labour), Mr. Butler said that the current civil allocation of plutonium and U 235 was sufficient for the programme of more advanced types of civil power and research reactors now in hand. The main limiting factor in that programme was the shortage of suitably-qualified scientists and engineers, both serving with the Authority and in industry. He added that the Government did not consider it necessary to publish a White Paper on the control of the private development of atomic energy or on the release of enriched uranium for civilian needs.

With respect to the Euratom proposals, the meetings of the O.E.E.C. Ministerial Council on February 27 and 28 gave much hope that the European nations would act together in exploring the possibilities of this new form of power.

OVERSEAS ATOMIC POWER STATIONS

In reply to questions by Mr. R. Moss (Labour), on another occasion, Mr. Butler said that the Authority had had discussions with a number of firms interested in the building of atomic power stations overseas. As to a statement by Mr. Moss that the United States Government had released no fewer than 40,000 Kilogrammes of uranium 235 for civilian and peaceful uses in that country and elsewhere, Mr. Butler agreed that he was aware of the situation in the United States, but added that his information came chiefly from the public Press. The Authority in Britain had held two meetings with manufacturers of heavy electrical plant to explore the possibility of export business in this respect.

Mr. Butler informed Mr. R. Mason (Labour) that he had seen reports in the Press of one agreement between an American and a British company to build nuclear power plants abroad, including Commonwealth countries. It was reported that the American company would design and supply the nuclear reactors and the British company the remainder of the plants. Neither the Government nor the Authority had been asked to give any assistance in this matter.

TECHNICAL EDUCATION IN SCOTLAND

The programme of developments in technical education in Scotland was the subject of a lengthy series of questions. Mr. J. Henderson Stewart, Joint Under-Secretary of State for Scotland, informed Mr. Malcolm MacPherson (Labour) that it was hoped that £3 million of the £10 million building programme for the central institutions and local technical colleges in Scotland mentioned in the Government's White Paper *Technical Education* (Cmd. 9703), would be commenced within the coming two years. Much, however, would depend upon the speed with which sites were acquired and plans prepared by the local authorities and institutions concerned. The Government hoped that the figure put forward would be exceeded, but they felt tolerably sure that at least a programme involving that amount of expenditure would be started within the period mentioned.

Also in answer to Mr. Malcolm MacPherson, Mr. Stewart said that the Central (Technical) Institutions were estimated to have about 3,200 places for day students. Extensions at present under construction and further extensions envisaged would provide about 1,500 additional places. This was the Government's minimum object and they would improve upon it if they could.

It was anticipated, Mr. Stewart informed Mr. W. Ross (Labour), that an additional 500 to 600 full-time teachers would be required to implement the Government's technical education programme. These teachers were expected to be recruited from among the existing large number of part-time further education teachers, from industry, and from among school teachers.

Deferment of Engineers

Mr. Frank Beswick (Labour) asked the Minister of Labour and National Service whether "in view of the over-riding need to achieve the most effective deployment of our scientific manpower," he would now reconsider his decision to call up engineering graduates of a recognised engineering Institution. In a written answer, Mr. Iain Macleod stated that the current arrangements for the indefinite deferment of engineers and scientists for certain designated work were limited, and covered, with very few exceptions, only men with university degrees.

Health of Welding Employees

Replying to a question by Dr. B. Stross (Labour), who asked for a statement on the research being conducted by the factory inspectorate on the industrial hazards associated with welding processes, and, in particular, into the composition of electrode coatings, Mr. Macleod said that a report on the health of welders had been published by the factory inspectorate in 1951. The conclusions arrived at in that report were, in general, reassuring, but the Factory Department was considering the question of possible health risks from low-hydrogen basic-coated electrodes. The strength of the factory inspectorate at the present time was considered to be sufficient, but this question was re-examined from time to time.

Social Effects of Automation

Urged by Mr. Frederick Lee (Labour) to set up a committee to inquire into the technical, economic and social problems raised by automation, Mr. Macleod suggested that it would be better to wait for the report of the Department of Scientific and Industrial Research on that subject before deciding upon future action. He was sure that it would be a valuable report, although he did not expect anything earth-shaking to emerge from it. On a later occasion, the Minister told Mr. Will Owen (Labour) that he would be happier about the appointment of a committee if he knew what the committee would be expected to do.

Nickel Ores in Southern Rhodesia

The President of the Board of Trade, Captain Peter Thorneycroft, told Mr. Frederick Lee (Labour) that no discussions were contemplated between the Government and the Government of Southern Rhodesia with regard to the indications of nickel-bearing ores found at Gatooma in South Rhodesia. He understood that the exclusive rights to explore these deposits had been acquired by a British mining company and that exploratory work was now in progress. This seemed to him to be a very satisfactory state of affairs.

Dollar Imports of Steel

Asked by Mr. Maurice Edelman (Labour) about dollar expenditure on the importation of sheet steel for the motor industry, Captain Thorneycroft said that imports in the twelve months ended January 31, 1956, from the dollar area of the type of sheet steel mainly used by the motor industry amounted to £17·4 million valued c.i.f. No information was available to show what proportion of this total was used by the motor industry. In reply to a supplementary question asking that the importation of hard-currency steel should be related to the export performance of the consumer, Captain Thorneycroft said that it was generally agreed that no scheme of allocations for steel ought to be introduced.

Diamond Wire-Drawing Dies

Questioned by Mr. R. S. Russell (Conservative) regarding imports of diamond wire-drawing dies, Captain Thorneycroft stated that these products were included, by value only, under the heading "Implements and Tools and parts thereof" in Division D.14 of the Trade and Navigation Accounts. Statistics supplied with his answer showed that in 1953 mounted and unmounted dies imported from the Netherlands were £5,542; from New Zealand, £1,709; and Belgium, £253; making a total of £7,504. In 1954, imports from Belgium, France, Sweden and "other countries" totalled £762. In 1955, imports were, respectively, Australia, £880; France, £522; the Netherlands, £19; Sweden, £1,250; and other countries £247; giving a total of £2,918.

New Dam on the Upper Nile

In reply to Mr. Hector Hughes (Labour), who inquired as to what progress had been made with the plans for a dam across the upper Nile near its source at Jinja on Lake Victoria, Mr. Alan Lennox-Boyd, Secretary of State for the Colonies, said that the Owens Falls Dam had been opened by H.M. The Queen in April, 1954. Owing to the increasing demands for hydro-electric power in Uganda and Kenya, however, a second dam would probably be needed by the early 1960's. Consulting engineers were at present engaged in examining a possible site.

Electricity from Wind Power

The Minister of Fuel and Power, Mr. Aubrey Jones, informed Mr. Harold Neal (Labour) that his Department was sponsoring a programme of research into the possibilities of generating electricity by wind power on a commercial scale and that that research was being conducted by the Electrical Research Association at Cranfield. The Department had also been contributing towards the cost of testing two large experimental windmills in other parts of the country. Mr. Jones felt that these experiments had been continuing over a sufficiently long period to enable the conclusion to be made that the probable contribution of this source of power towards the country's coal economy was likely to be small: no more than between two million and five million tons of a coal a year.

THE HUMAN ELEMENT

Increased efficiency a necessary concommitant of higher wages—Inflation hits union funds—Mobility of labour and individual security—Trend towards time rates?—Overcoming resistance to automation—Employers' Federation turns down equal pay for women.

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Higher Wages

The increase in wages granted to draughtsmen, clerks and scientific workers last week in the engineering industries brings another 440,000 into line with the 3¼ million workers granted increases on March 1. The agreement between the Confederation of Shipbuilding and Engineering Unions and the Engineering and Allied Employers' Federation provided for an 8 per cent. increase on basic wages. This amounted to 12*s.* 6*d.* a week for skilled workers, 11*s.* for semi-skilled and 9*s.* 6*d.* for unskilled. The increases granted to draughtsmen, clerks and scientific workers range from 13s. a week for a man of 21 to 15*s.* a week for a man over 25. Women's wages will be raised by 9*s.* 6*d.* a week.

The stage is now set for a year which, for British engineering, is unlikely to be an easy one. Export markets are becoming more competitive and a major effort is required to stem the gains made by German and other European engineering products in the proportion of world trade for which they account. High wages are not necessarily a stumbling block to increased efficiency and lower real costs, since they are a powerful incentive to investment in up-to-date plant. The proof of this is that the leading companies in various sections of the engineering and metal industries almost invariably pay wage rates substantially above the average. But the industrial climate is changing and may change even more quickly during the next few months. The challenge to industry, managers and workers alike, is building up to something quite substantial; stable costs and the ability to quote firm prices may be decisive factors not only in the country's export drive but in each company's prospects.

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Trade Union Reserves

A recent Trade Union Congress survey of 123 unions shows that the trade union movement is not unaffected by inflation. It has been apparent for some time that although several of the larger unions have big invested funds, there are a large number which are operating under difficult financial circumstances. Administrative costs have gone up more quickly than income, and important work on propaganda and education is hampered by lack of money.

Spending by unions on administration was three times higher in 1954 than in 1939. On the other hand, membership has increased and contributions have gone up to some extent. In consequence, administrative costs per union member have increased by only 82 per cent. Such a rise is, however, serious enough. Twenty-five unions had not increased their levies over that period and one union has not raised its contributions for 50 years. Other causes of rising costs have been superannuation, cash and other benefits of the welfare age. One way and another, three-fifths of the unions making a return under the survey spent more than their total income from contributions—to the tune of over £500,000 in all. One union in six, mostly small ones, had to draw on their reserves. The amounts being put to reserve are falling seriously.

An army fights on its stomach. A union fights on its funds. A recent object lesson in this was the comparative power of the typographers in the recent printing dispute compared with the locomotive men last summer. More than that, if the unions are to get good men they must pay for them accordingly, and they cannot pay adequate salaries if they are under constant pressure to economise.

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On Being Redundant

"Redundancy" is a word heavily charged with emotion in industry. The British Productivity Council has now issued a pamphlet called "Productivity and Redundancy" as number six of its action series. It is a genuine effort to explain that redundancy in any healthy economy is the price of change, of progress. Unfortunately, redundancy is a coin in which individuals pay. It brings the high-flown theory of the need for mobility of labour into the weekly pay packet. It involves "me" as opposed to "them." It is the ideal medicine for the other chap and bane for "me."

The pamphlet shows that redundancy is, in a degree, inevitable and that it runs counter to the individual's desire for security. It shows what the Government can do and what the employer should do when some redundancy becomes inevitable. The pamphlet is at its weakest in dealing with what the Government can do. In its efforts to raise the pamphlet above party issues (the booklet has the blessing of both sides of industry, the Government and Mr. Gaitskell) it skates over the fact that redundancy may have to be created in order to move resources and men to other industries no matter how efficient by normal criteria an industry may be. For example, you may have to create some redundancy in order to force an already efficient motor-car industry to reduce its costs and so export more. It is something of an achievement, however, to have got such a large measure of agreement on such a difficult subject from both sides of industry and from both major political parties.

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Time, Gentlemen, Time

Some of the basic differences in outlook between factory workers in the U.S. and the U.K. are illustrated by the new proposals by Vauxhall Motors to replace bonus payments by straight time rates which were accepted by the operatives last week. In general, U.S. factory workers want productivity to increase both as a result of rapid mechanisation and of improved management methods, and their main preoccupation is to ensure that they get the biggest possible share of the benefits. Many British workers are still frightened by the white-bearded bogey-man of unemployment.

That U.S. workers are not unconcerned with continuity of employment is apparent from the importance which was attached to the Guaranteed Annual Wage negotiations in the motor industry. But employers in the U.S. are well aware that rapid mechanisation and improvement in methods necessarily involves constant revision of time-study work, which is expensive and not popular with their employees. Although the majority of the latter probably accept the fact that new machines and methods must involve new times, a minority always tend to look askance at what they think may be "fiddling with rates."

On the other hand employers in the U.S. are able to take a tougher line with those who, when on time rate, do not pull their weight because the majority are keen to increase productivity with resultant benefit to themselves. Whether the same would hold good in Britain is more doubtful, and although it is said that most Vauxhall employees will receive increases under the new agreement it will be interesting to see what happens if a minority fail to exert themselves and, as a result, receive a low merit rating.

The scheme should be popular with foremen and supervisors and should assist in promoting recruitment to their ranks. Hitherto quite a lot of good factory workers have refused a foreman's job partly because it often [illegible]ans a drop in earnings, though dislike of [illegible]ponsibility, so widespread among British [illegible]ge earners, is probably also an influence.

It seems possible that a lead[illegible] this magnitude will encourage the introduction of merit rating in small companies where the cost and difficulties of introducing incentive bonus schemes based on work study have hindered their progress. Nevertheless the number of factory workers whose earnings are based on work-studied bonus incentive schemes is likely to increase further before it declines as a result of what may be a new trend.

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Automation Worries

Experience in the United States suggests that the telephone industry may prove one of the main testing grounds for automation's claim to popular support. The introduction of automatic switchboards in the 10 years 1945 to 1954 has led to a decrease in the proportion of switchboard operators from 52 to 39 per cent. of the total labour force involved. As could be expected, the proportion of construction, installation and maintenance workers rose, from 17 to 24 per cent. and—more surprisingly perhaps—that of clerks rose also, from 16 to 20 per cent. So far the rapid growth of the industry has prevented redundancy from becoming a major problem; in fact there has been an increase of 16 per cent. in the number of switchboard operators employed.

So long as the rate of expansion is maintained in those industries where automation is introduced there is a good chance that adjustments in the labour force can be made simply by slowing down recruitment. There is, however, suspicion and distrust on the part of the operative, or so-called production worker. American trade unions have been quick to point out that the re-training and transfer of affected workers will become an essential feature of the spread of automatic techniques. Eventually, as the rate at which labour is economised exceeds the rate of industrial expansion, the U.S. operatives advocate a shorter working week.

There is little doubt that the problem of re-training will have to be faced in this country, before very long in certain industries. Unless adequate provision is made for this the British worker is no more likely to support the introduction of new and better machines than his American counterpart.

★ ★ ★

Unequal Women

Women workers in the engineering industries have failed in their claim for equal pay. The Engineering and Allied Employers' Federation turned it down flat and their counter-offer of increases proportional to those granted to male employees last month has been refused by the engineering unions. The matter is now considered to be "in dispute." A request made to the Minister of Labour to set up a Court of Inquiry was turned down but the Ministry's chief industrial commissioner will invite representatives of the unions and, subsequently, of the employers to state their views.

Some 200,000 women are employed by members of the Employers' Federation, and the increase claimed — £1 17s. 10d. a week in the basic wage—would have added about £23½ million to the annual wage bill of Federated firms. If companies outside the Federation are included, between 400,000 and 500,000 women are affected and the total cost would be about £50 million a year. This compares with £80 million a year for the increase granted to the men in the same unions. The claim is therefore a very major one, and is likely to be fought tooth and nail by the employers. The issues raised are, of course, quite different from those of a normal wage claim and will need a wide airing before they are generally understood in an industry where women are, by long tradition, most unequal.

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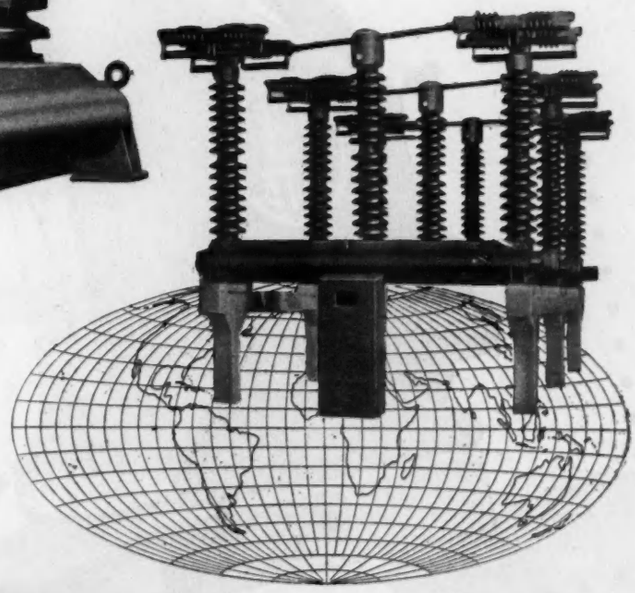

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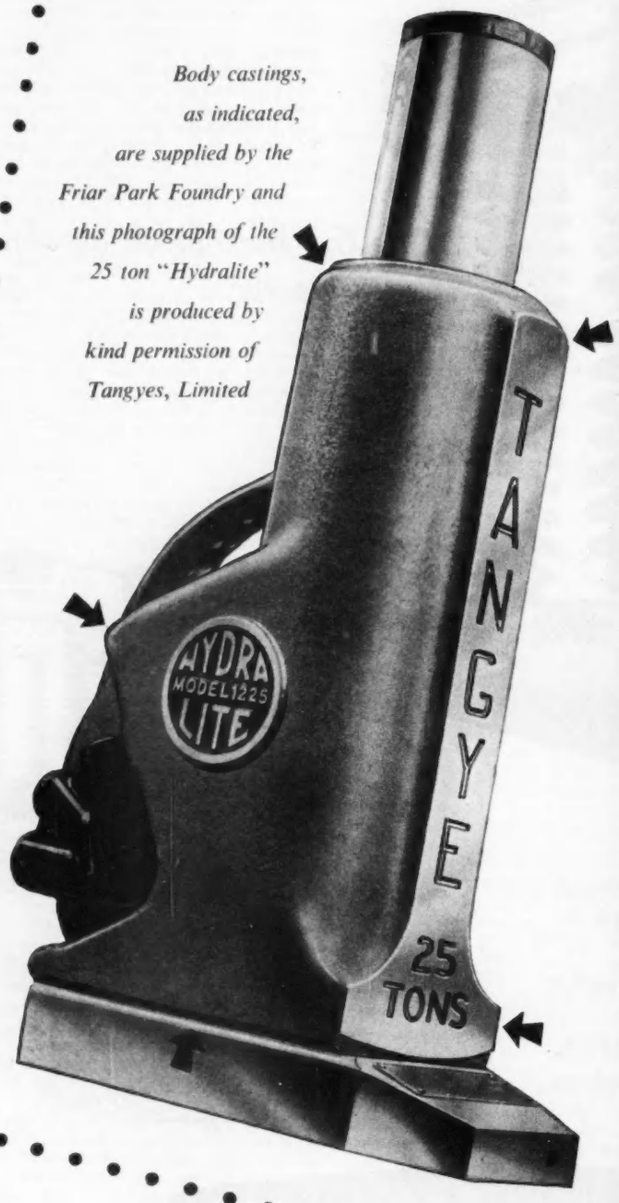

Body castings, as indicated, are supplied by the Friar Park Foundry and this photograph of the 25 ton "Hydralite" is produced by kind permission of Tangyes, Limited

By well considered designing and careful choice of modern materials, Tangyes, Ltd. of Birmingham have produced the "Hydralite" range of light-weight jacks. Produced mainly from aluminium alloys, with no sacrifice of the safety margin, they will lift 15 to 50 tons and yet themselves are lifted by one hand. This 25 ton Jack weighs only 53 lbs.

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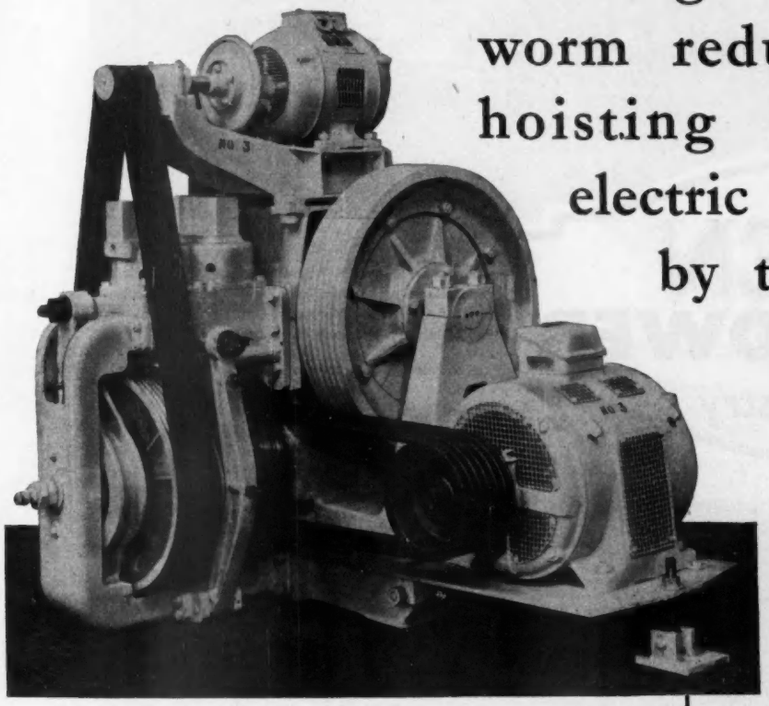
APIM-10

Turners Multi Vee Rope Drives play an important part in connecting the main motor and the levelling motor to the worm reduction gear in hoisting machines for electric lifts. As used by the Express Lift Company Ltd.



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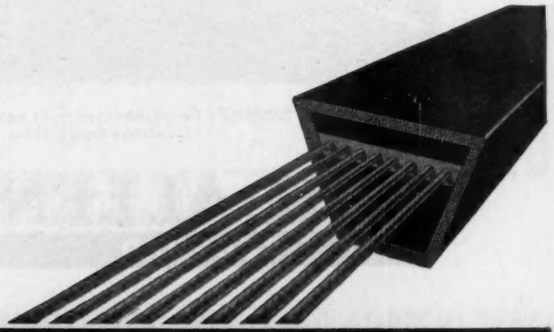

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V 34

ALLEN DIESEL POWER for Industry

A modern power house equipped with diesel generating plant is an important part of the electrification of the large Worsted Spinning and Weaving Mill of John Priestman & Co., Ltd., Bradford.

A section of the diesel plant installation (illustrated), comprises two 8-cylinder, 1,080-b.h.p. Allen two-stroke engines running at 375 r.p.m., driving 750-kW alternators wound for a 6·3 kV, 50-cycle, 3-phase supply. The total generating capacity of the plant installed is 2,680 kW, including a 250-kW Allen turbo-generator which can be run in parallel with the diesel sets if required. This turbo-set was in service with a variety of reciprocating steam plant prior to electrification.

Power is transmitted on a ring main to five transformer sub-stations, where the voltage is reduced to 415 for power and 240 for lighting.

The modernisation of the power plant at this mill has effected a substantial reduction in power costs.

ALLEN DIESEL ENGINES: Two-stroke type (built under licence from Harland & Wolff Ltd.)—360 to 1,080 b.h.p. (216 to 750 kW) Four-stroke types—115 to 710 b.h.p. (75 to 450 kW). *Speed range*: 333 to 750 r.p.m.

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Bore	3½"	3½"	4½"	3½"	4¾"
Stroke	5"	5"	4¼"	5"	5"
No. of Cylinders	3	4	4	6	6
Swept Volume: Litres ..	2.36	3.14	4.42	4.73	7.36
Cu. ins. ...	144.3	192.4	269.5	288.6	450.8
Normal Max Speed R.P.M.	1,800	1,800	1,800	1,800	1,800
Brake Horse-powers:					
at 1,000 r.p.m.	15.75	21.5	31	32.75	51
1,200 ,,	19	26	37.5	39.75	61
1,500 ,,	24	32.5	46	49.75	76
1,800 ,,	28.25	37.5	53	57.5	89

(Based on 12-hour continuous operation under the specified conditions of B.S.S.649/1949)

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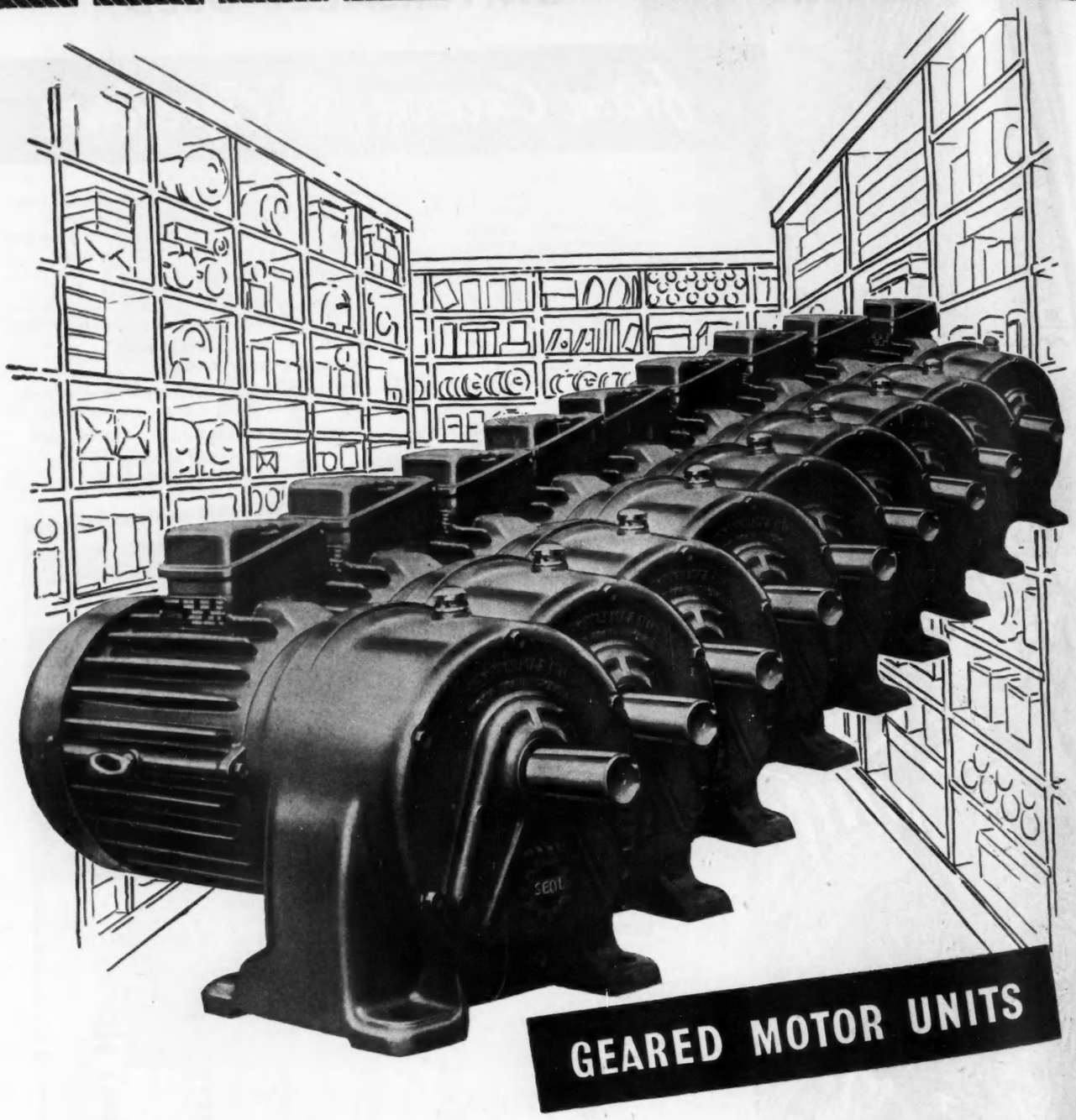

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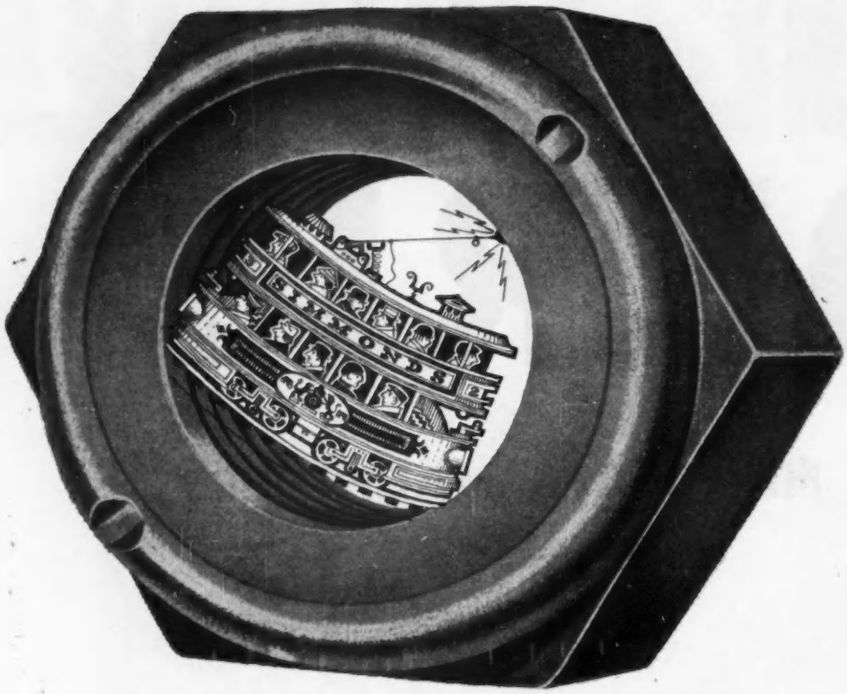
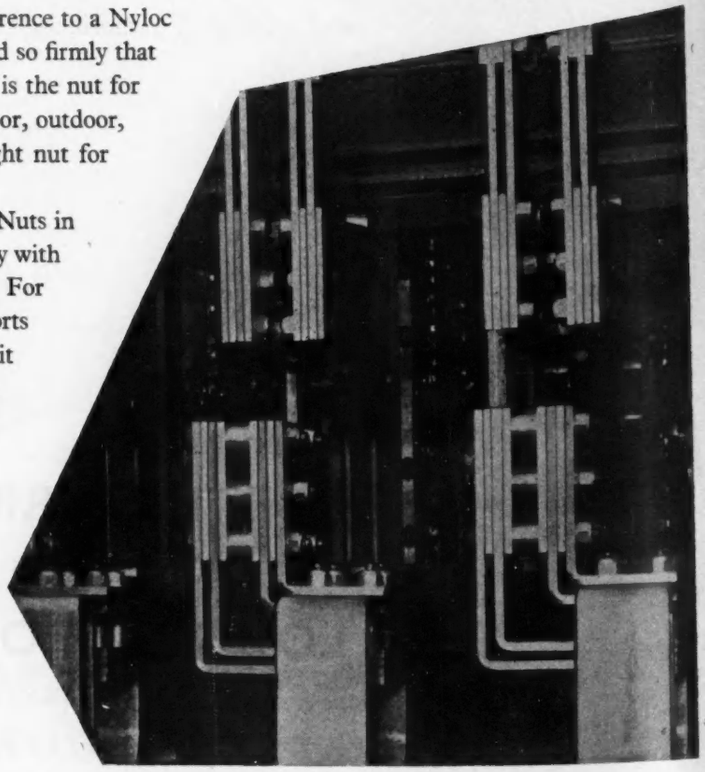


. . . but nothing shocks the NYLOC

24-volt or 232,000-volt Switchgear—it makes no difference to a Nyloc self-locking nut. The nylon insert grips the bolt thread so firmly that nothing (except a spanner) can disturb it. The Nyloc is the nut for any type of switchgear—oil immersed, air break, indoor, outdoor, contactor gear or flameproof equipment : it's the right nut for *any* location where a normal nut would work loose.
George Ellison Limited have found that using Nyloc Nuts in the assembly of their distribution switchgear does away with the need for constant inspection and maintenance. For example, they use 200 $\frac{3}{8}$" Nylocs on the busbar supports and contact assemblies of every 3,000 amp. circuit breaker. Equally tenacious are our Fibre Nuts and Pinnacle Nuts. We'll be glad to advise you which type of self-locking nut is best for your purpose.



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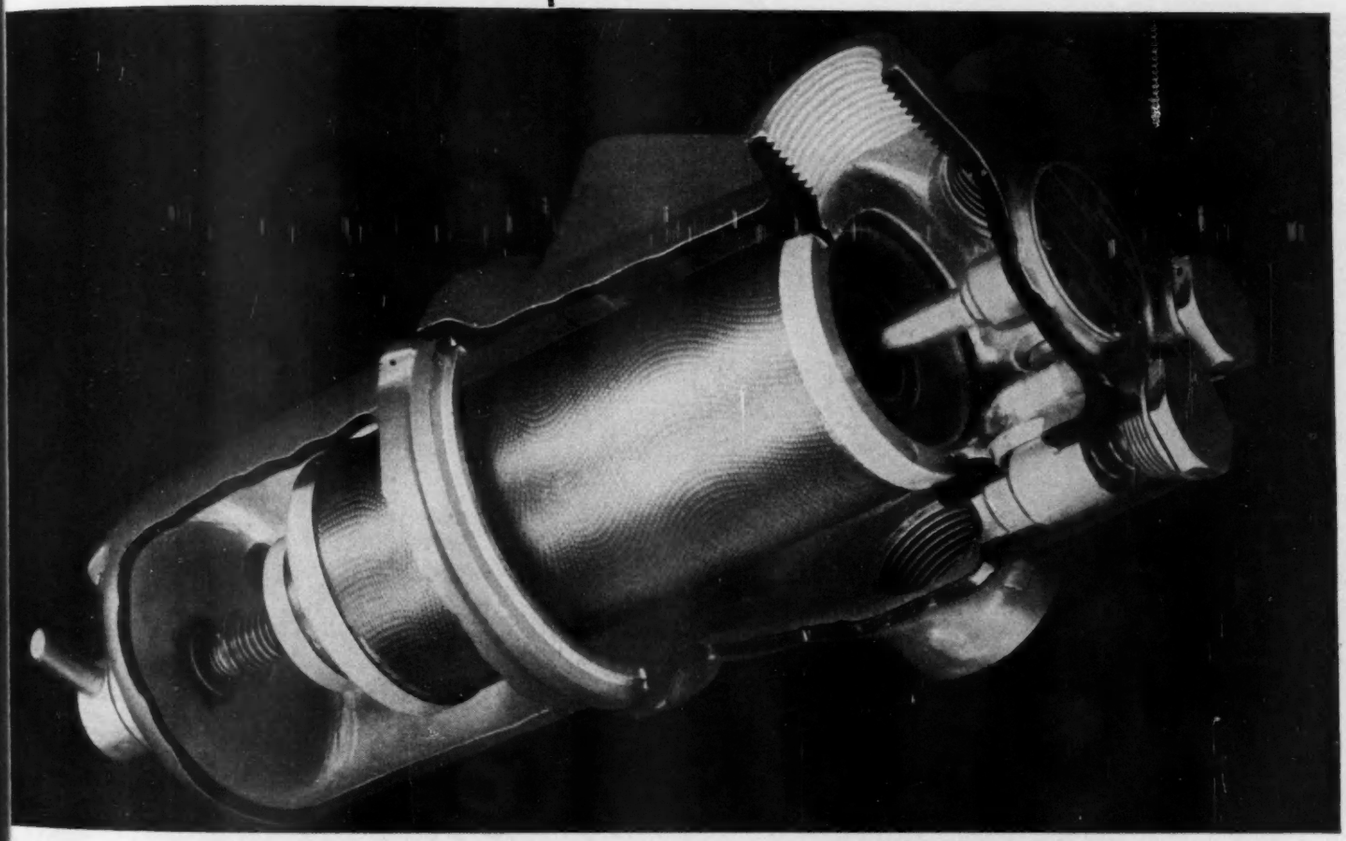

In the filtration of corrosive liquids, the choice of the right material in the filter is of first importance. In oil and petrol engines, for example, lubricating oils are often contaminated by corrosive products of combustion which can attack the filter element and impair its efficiency.

One company, the Automotive Products Co. Ltd., have overcome this problem with Monel. In the Purolator Filter, shown here, both inner and outer coiled elements consist of wedge-shaped wire of this material. With its high corrosion-resistance, this Wiggin nickel-alloy ensures long and effective life for the elements. Ease of working, strength and rigidity are other outstanding advantages. In this way, Monel is meeting the most exacting needs for efficient and continuous oil filtration today, in the Bristol, Alvis and Napier aero-engines, in Rotol gear boxes, De Havilland gas turbines and in the Armstrong-Siddeley feathering pump.

This application is typical of the many ways in which Monel and other Wiggin nickel alloys are meeting severe corrosive conditions.

OUR TECHNICAL SERVICE
is ready to give advice on the choice of suitable materials for resistance to corrosion or exacting temperatures. Full technical data on Wiggin nickel alloys are available on request.

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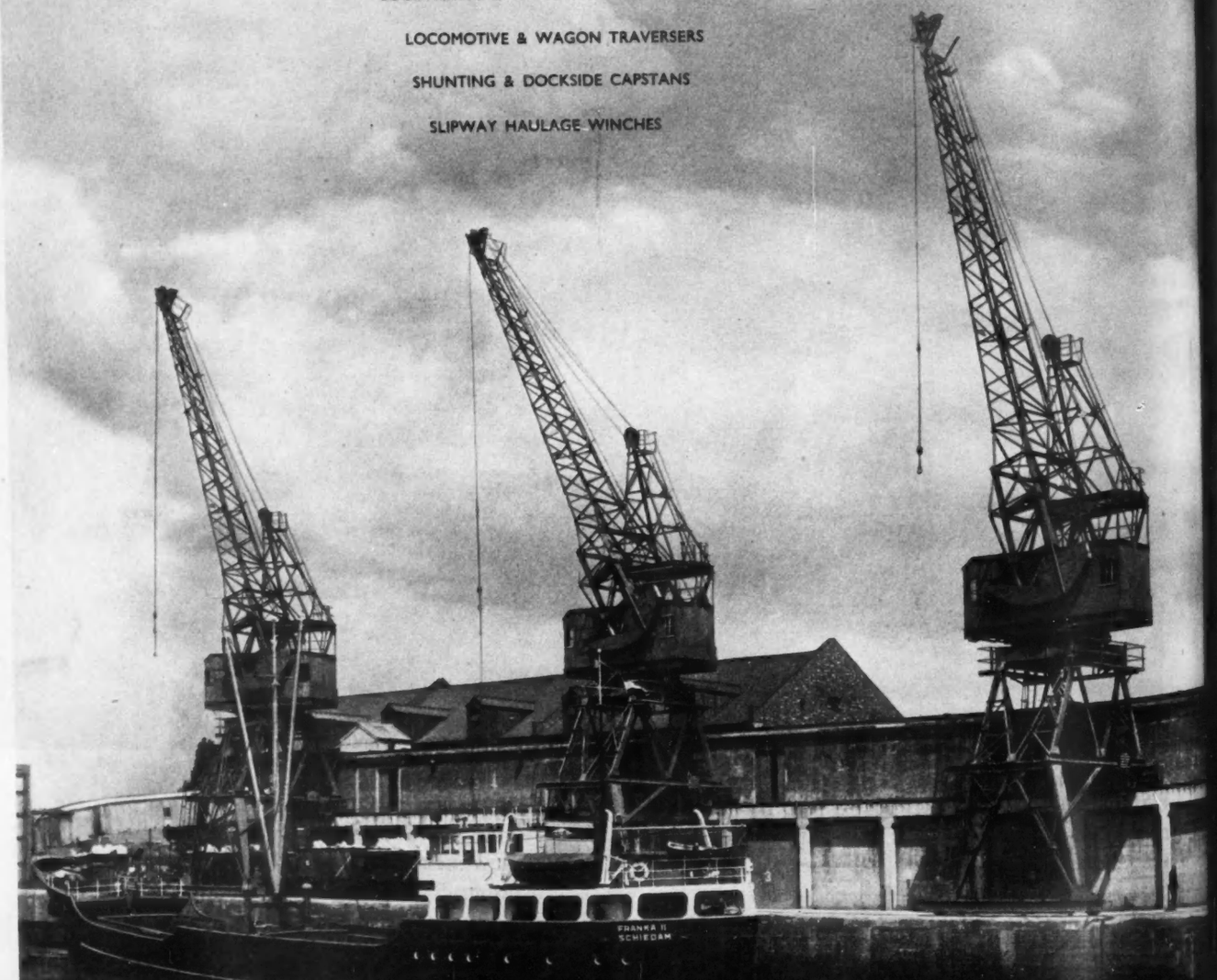

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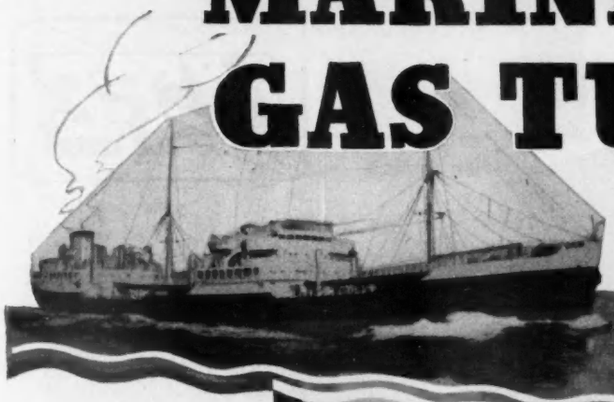

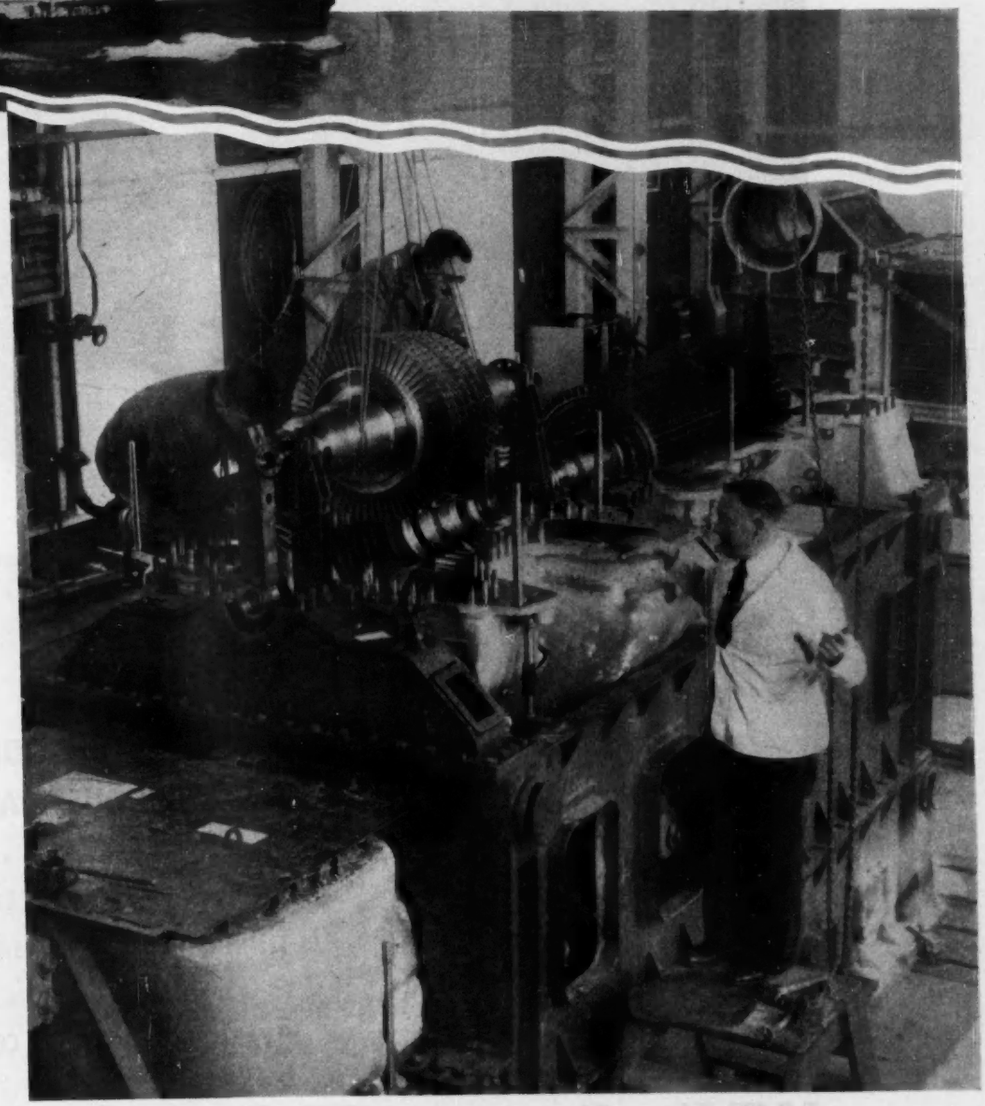

High-pressure turbine rotor and axial compressor rotor of BTH 1200-h.p. gas turbine installed in the Shell Tankers ship "Auris" of 12,000-tons dead weight.
This was the first ocean-going ship to include a gas turbine in her main propulsion machinery.

Photograph by courtesy of:— The British Thomson-Houston Co. Ltd.

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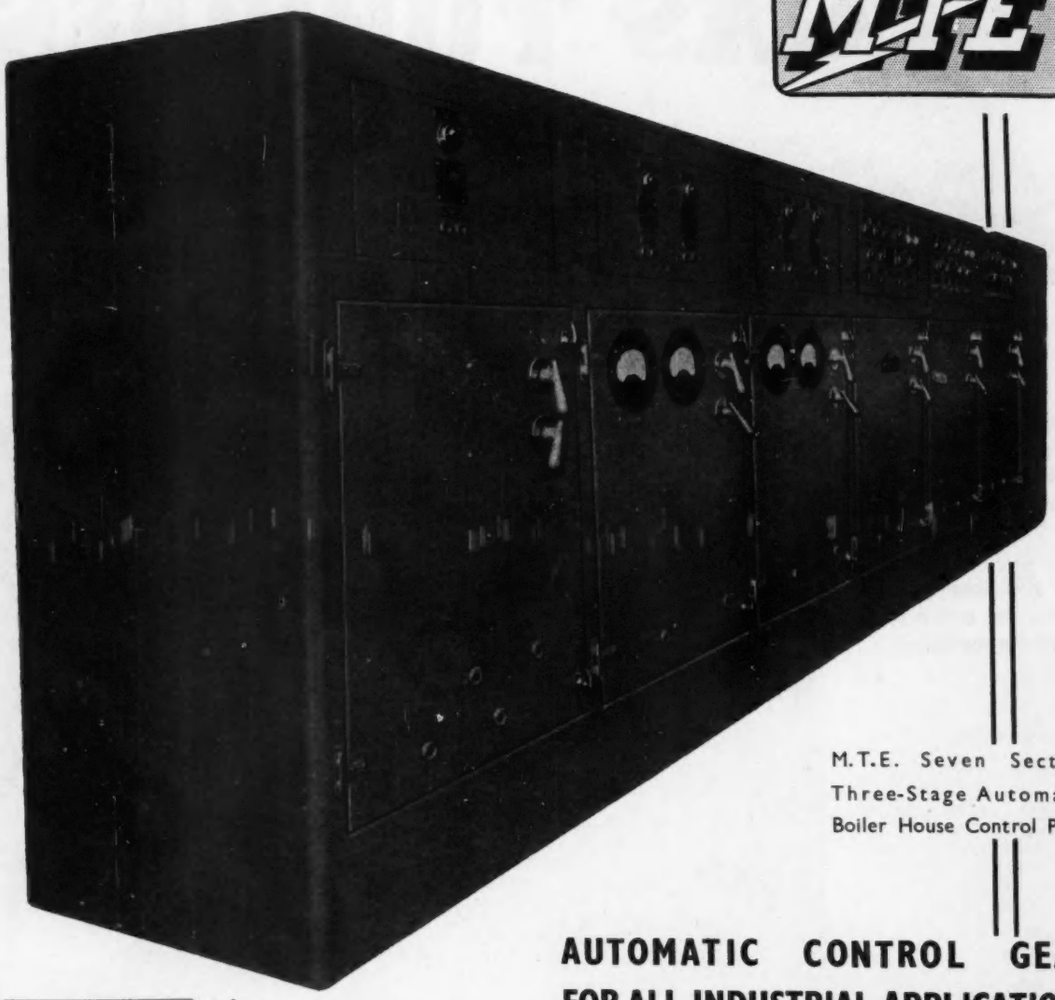

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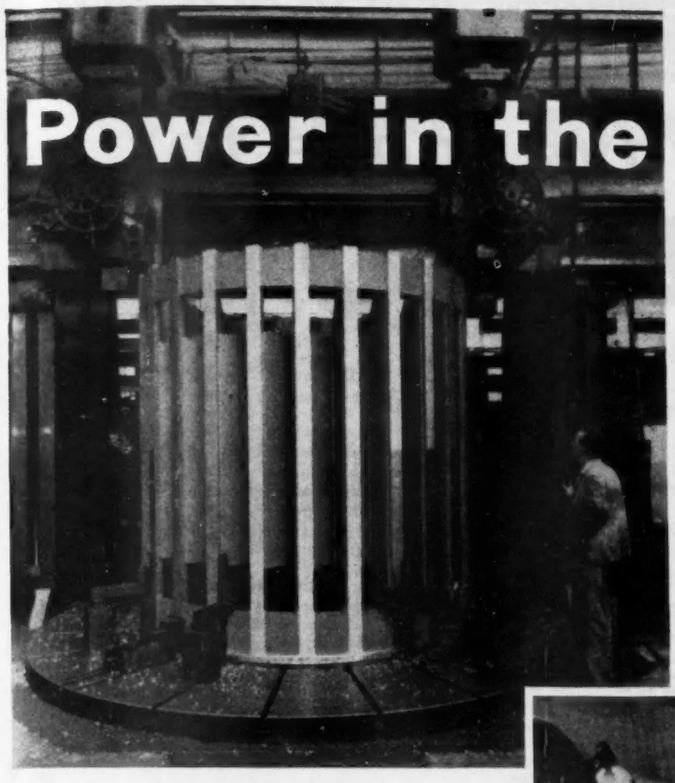

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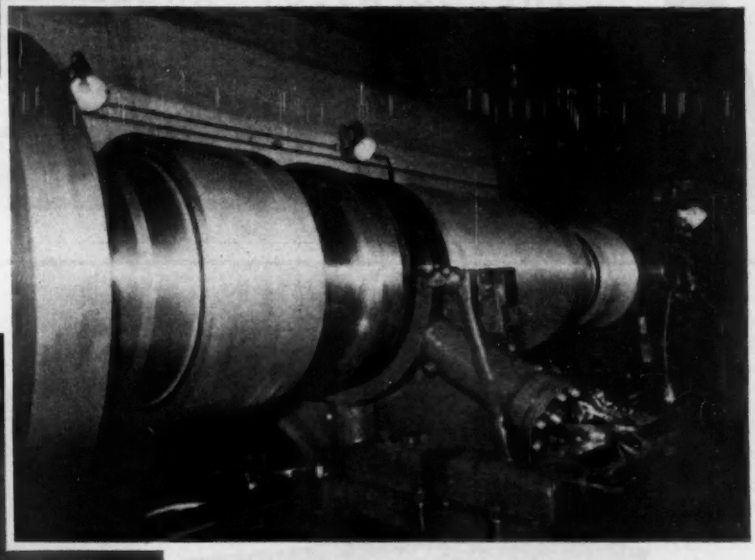
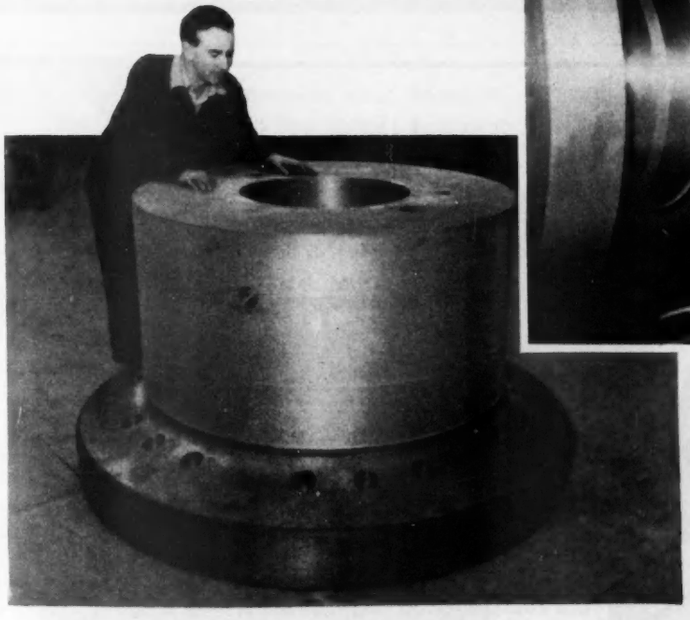
Vertical water wheel generators of larger capacity than any hitherto constructed are being built by Metropolitan-Vickers for the Bersimis Lac Casse development of the Quebec Hydro-Electric Commission. Four generators will be supplied, each having an output of 138 MW at 277 r.p.m. These photographs illustrate some of the work in progress.

Machining the rotor spider



Machining the rotor shaft. The completed rotor will weigh 300 tons.



The thrust block which will carry 360 tons dead weight, and 190 tons of water thrust.

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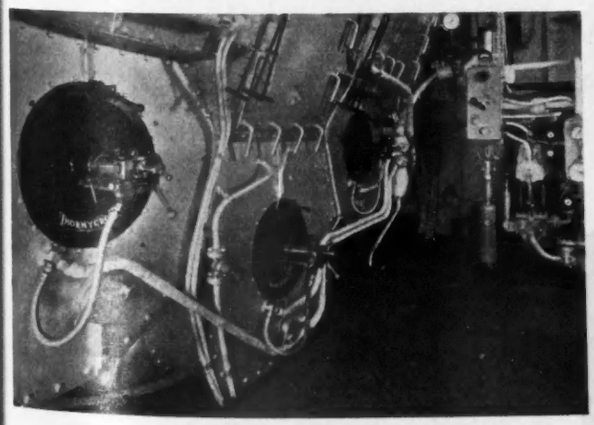
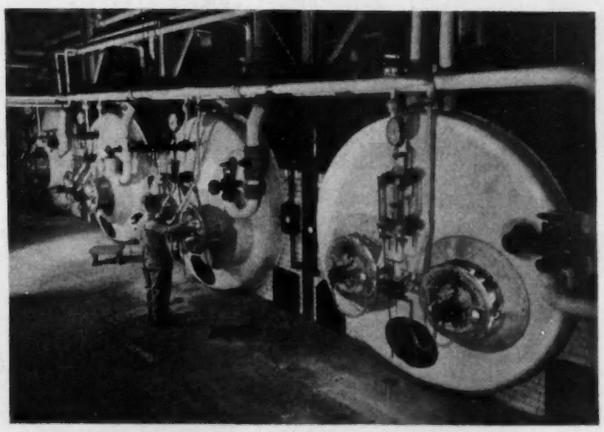


High pressure oil fuel installation in the tug "Horus" built by us for the Suez Canal Company.



Part of the installation at Messrs. Courage's Alton Brewery.

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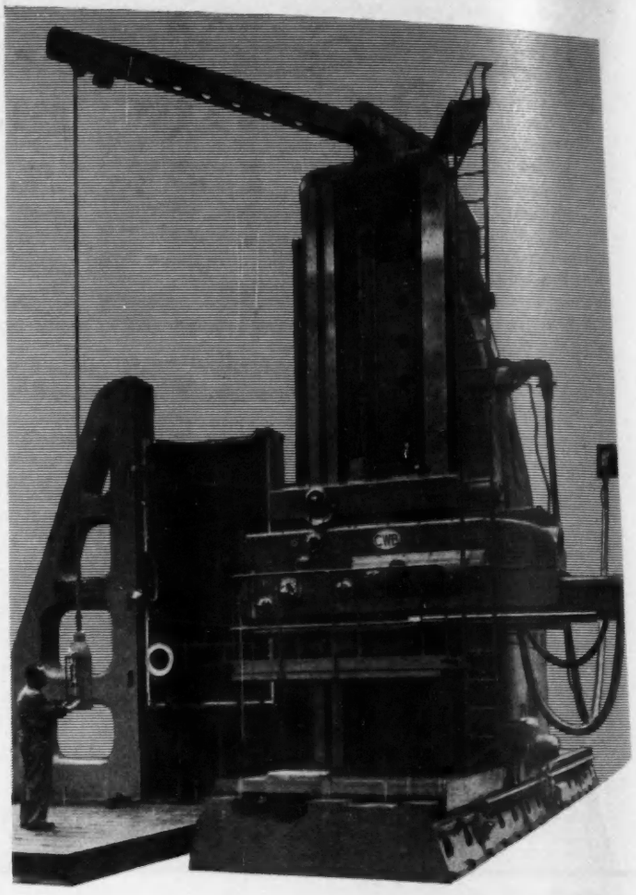

A large Diesel engine bedplate at Queen's Island, Belfast. F.A.F305/200 floor type machine, contour milling.

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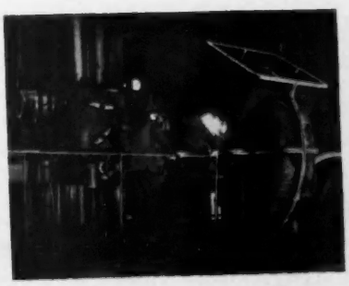
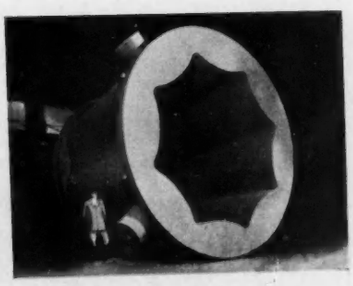
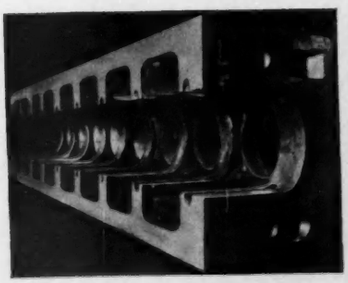
In the half of the fan casing (above) our hound Rollover could find only one blow hole—the flanged aperture at the top. (Right) we see the same casting with its mate in one of our machine shops. The machine operator, moleskin waistcoat type, cannot be told anything about horizontal boring. He won't lay a bead on a hare unless it's on the beam, 100 yards min., small bore ammo, gale warning cones hoisted. To him, a micrometer is as crude an instrument as a wagon weighbridge is to an analytical chemist.

Our own analytical chemists watch the quality of our West Coast Hematite iron like hawks. Not a pip too much of sulphur; not a trace of harmful residual elements to cause premature cracking, or the metal would be doomed to be used for making door stops. We make castings in grey iron and special irons. We machine them. We relieve the stresses in them. The stresses in ourselves are relieved by the heat of the chase.







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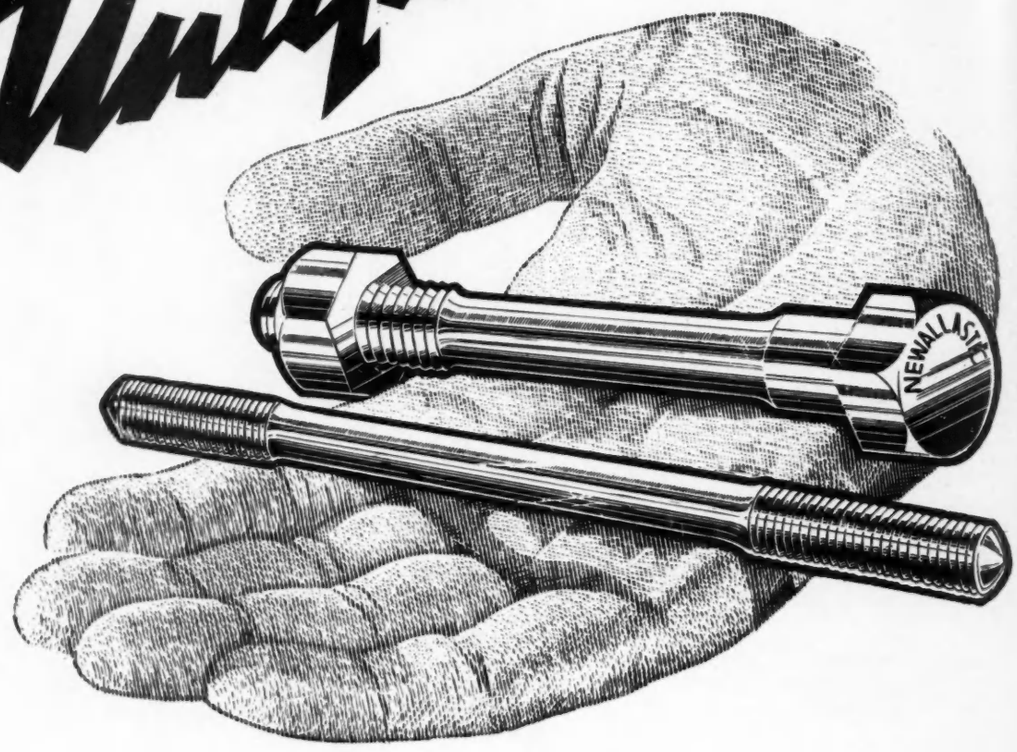

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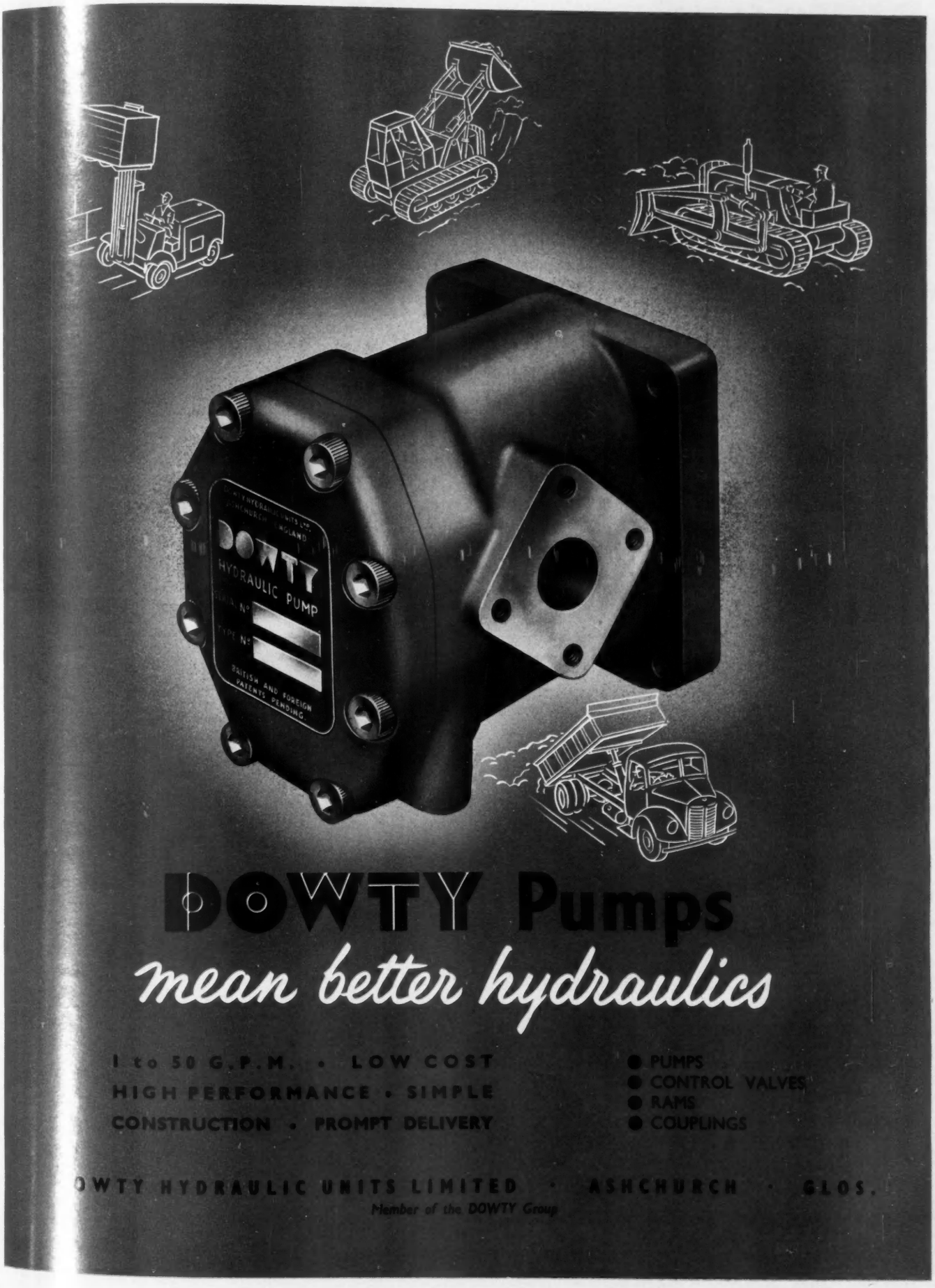
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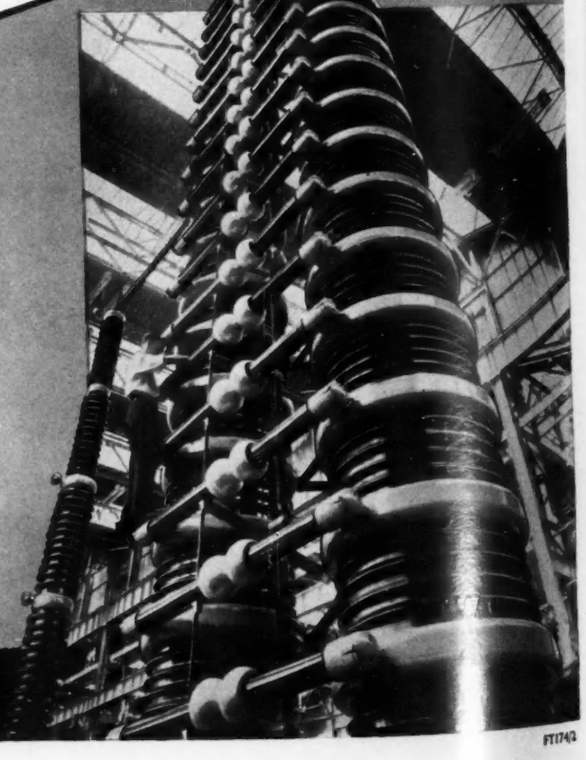

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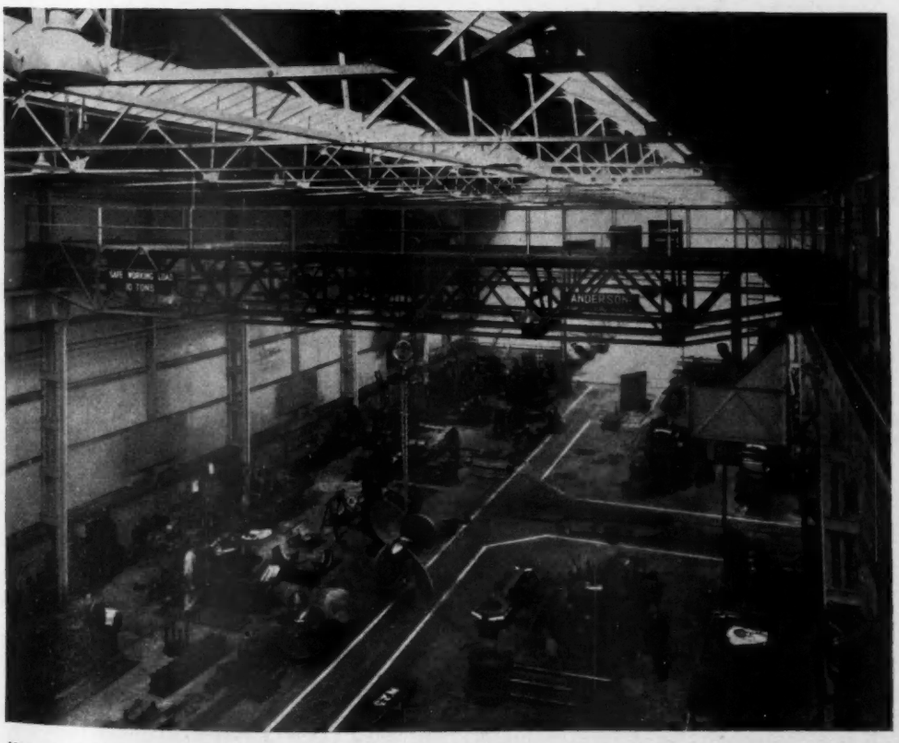

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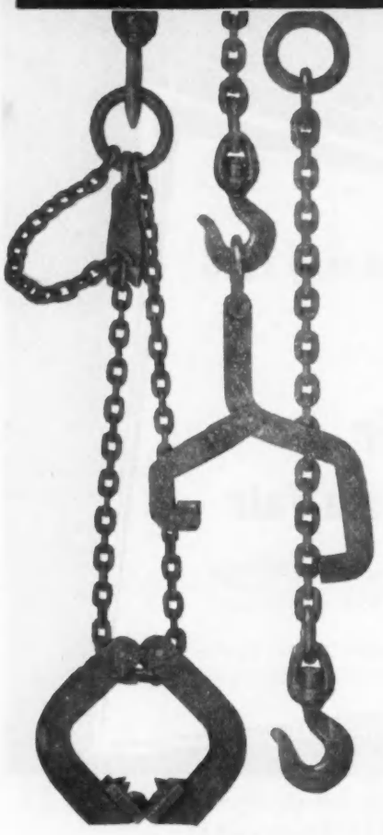

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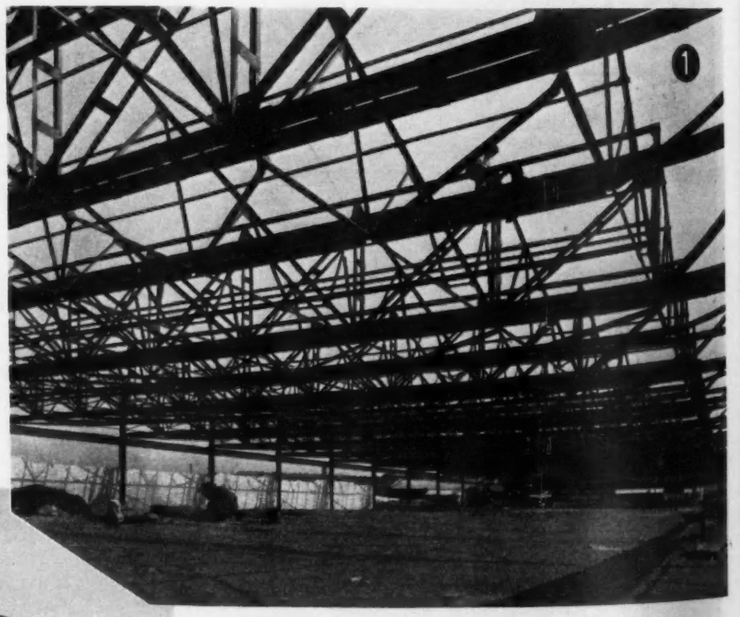

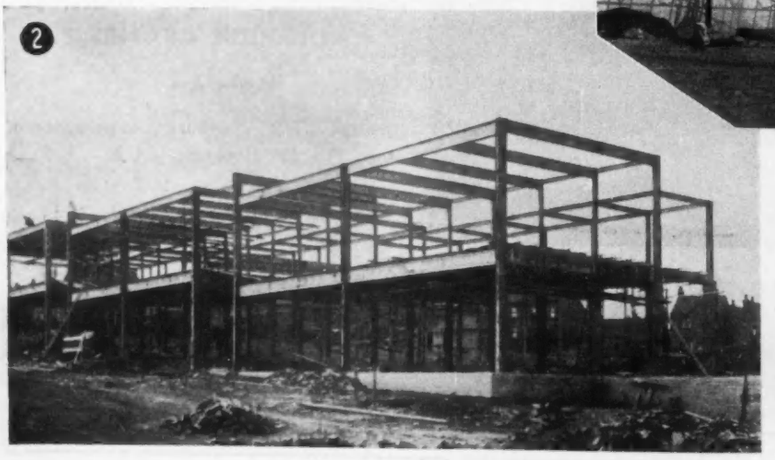

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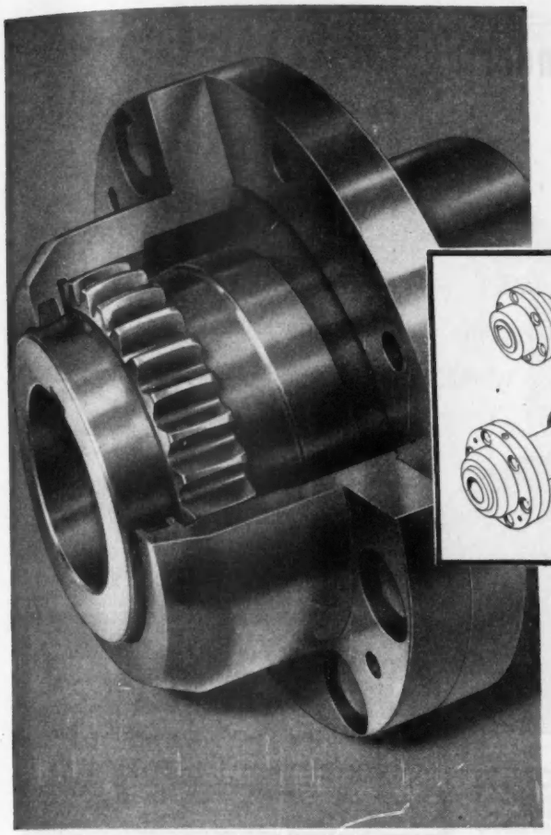

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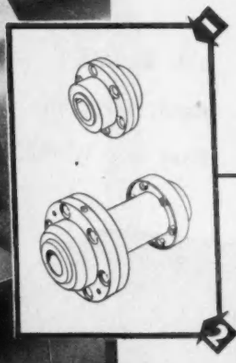

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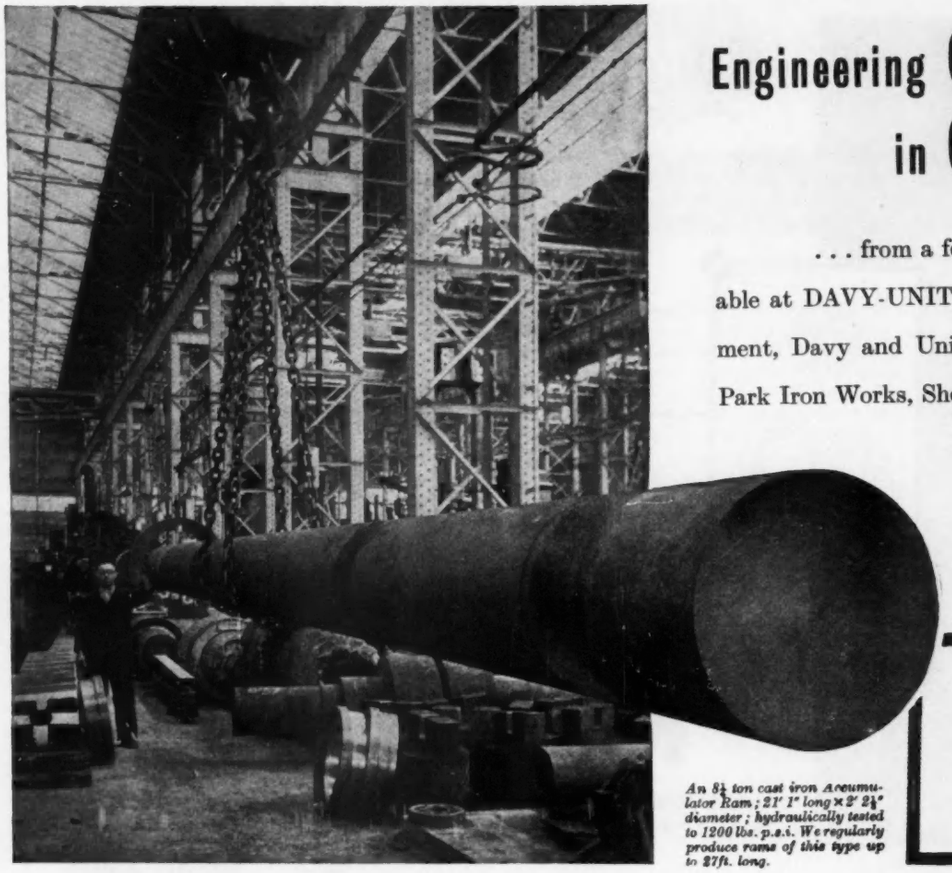

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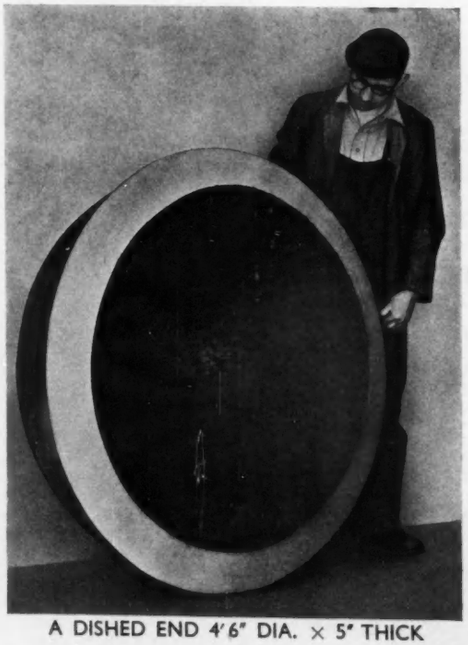

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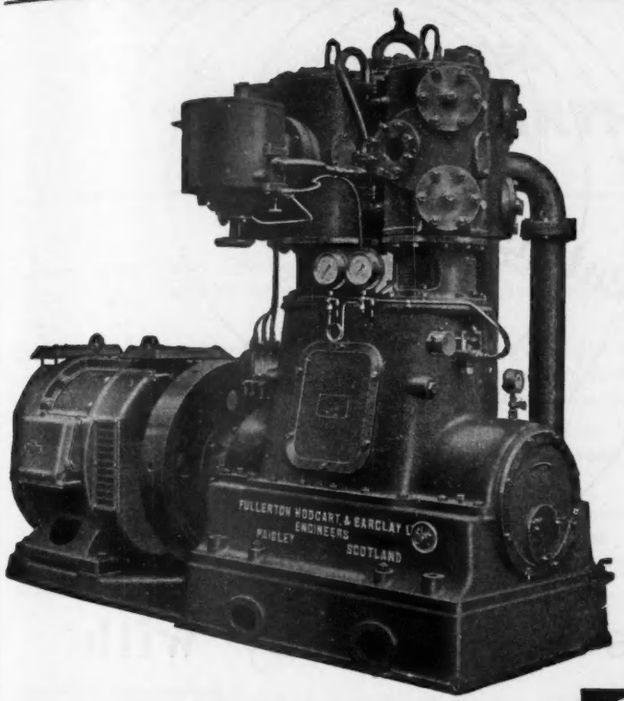

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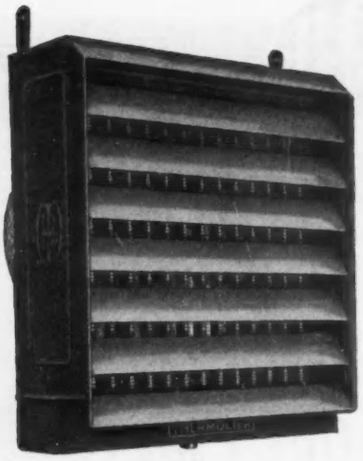

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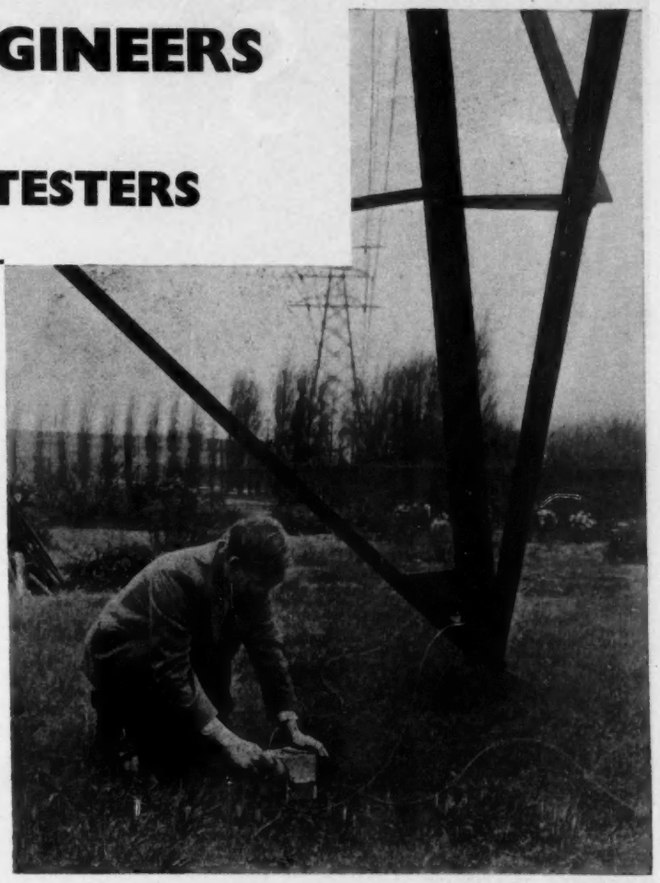

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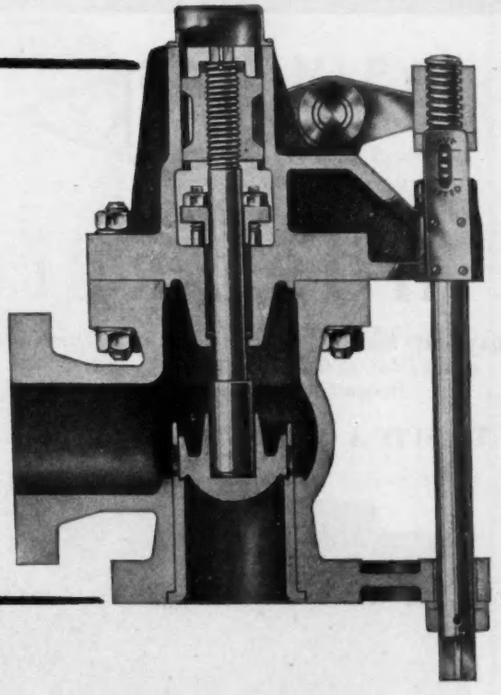

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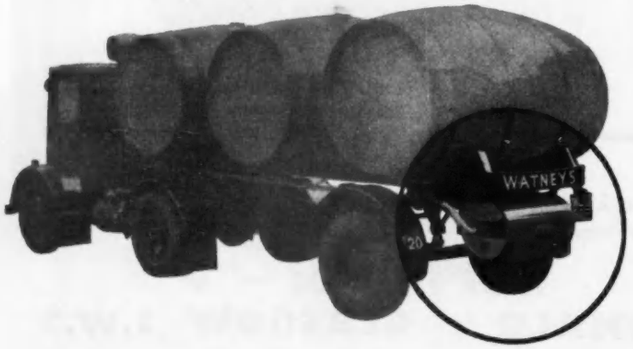

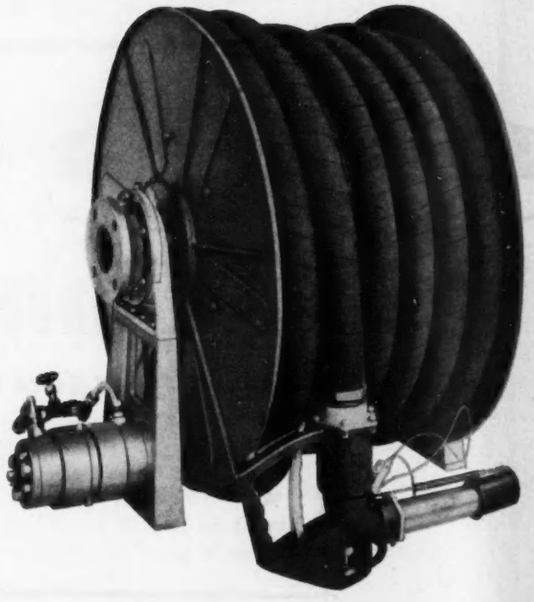

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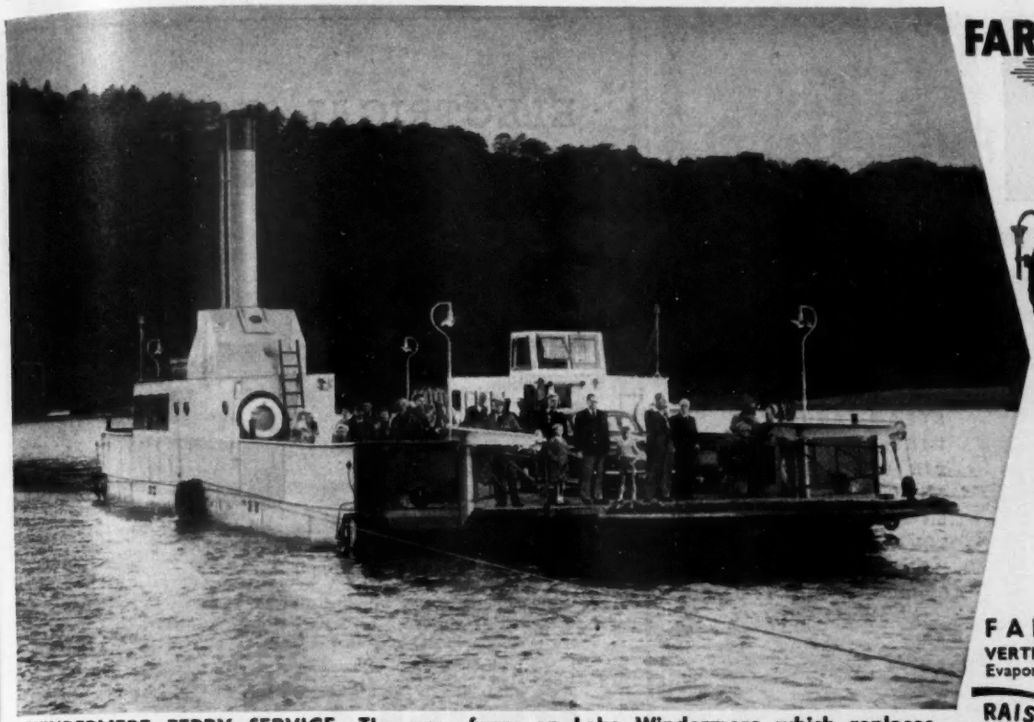

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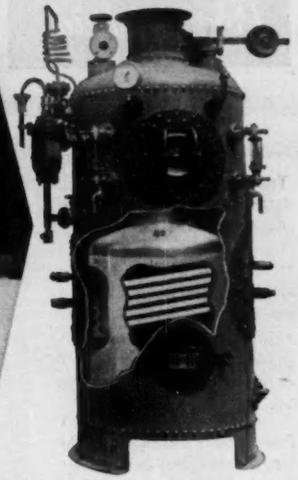

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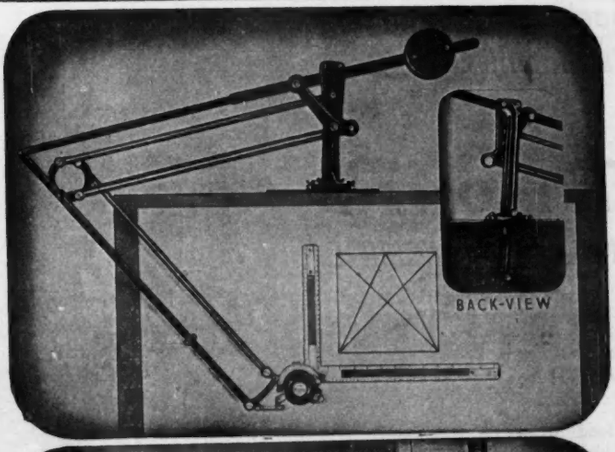

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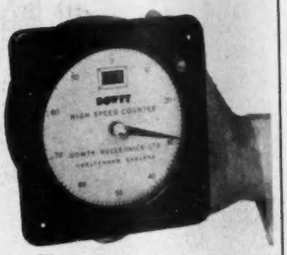

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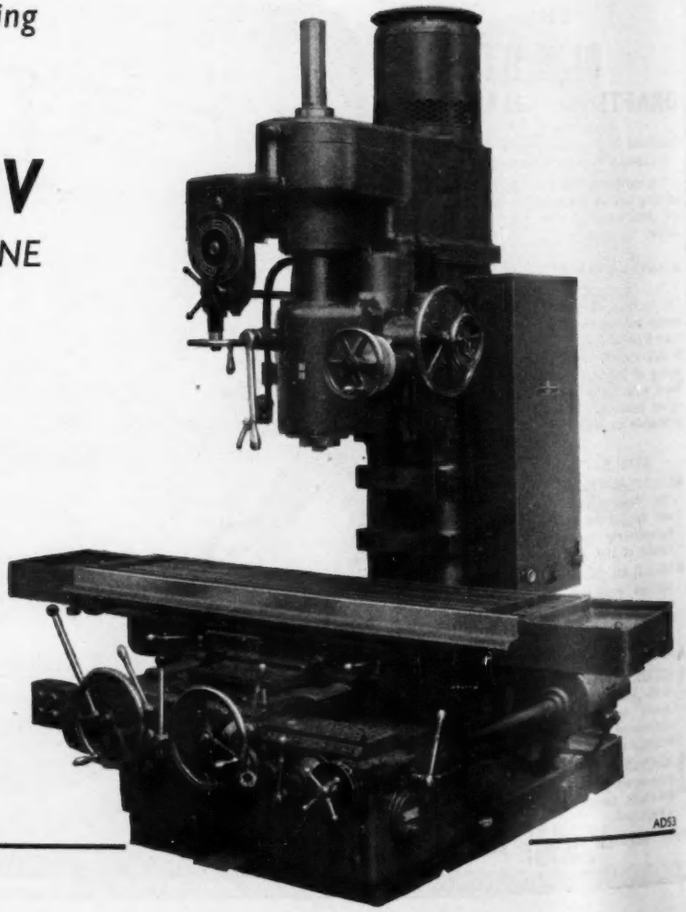

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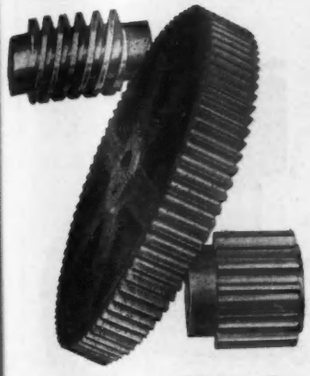

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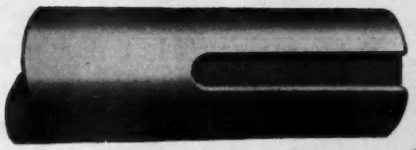

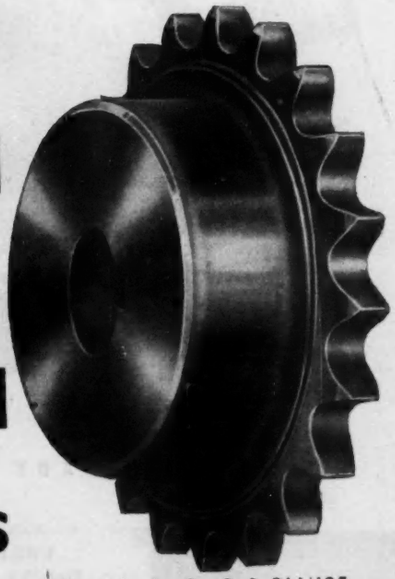

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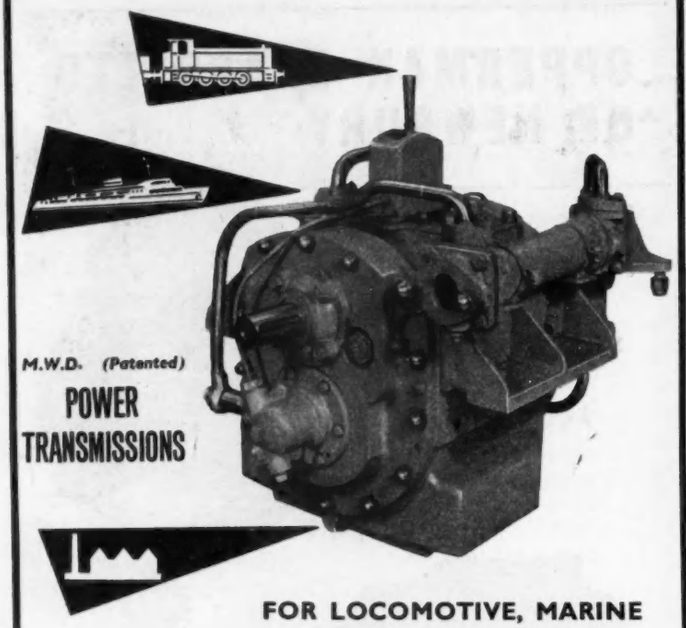

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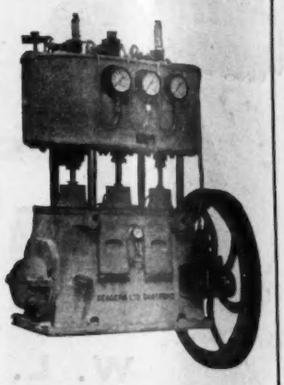

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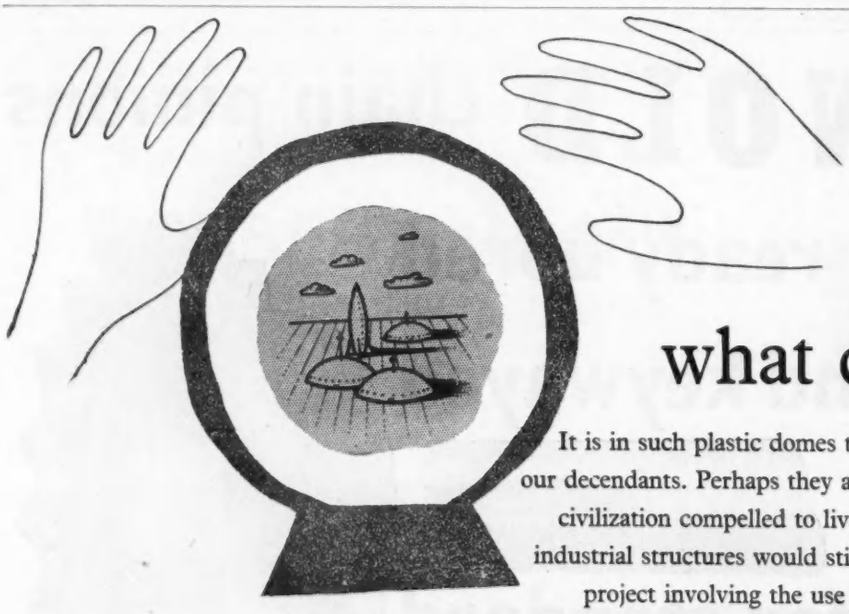

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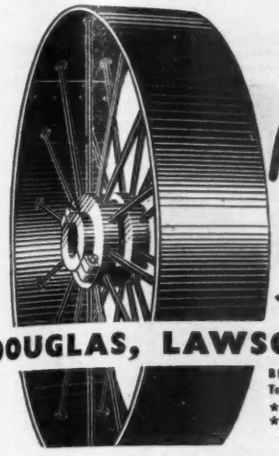

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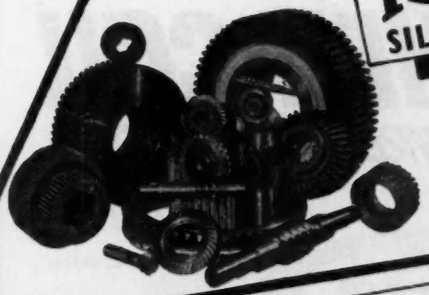

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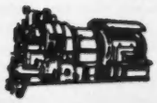

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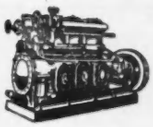

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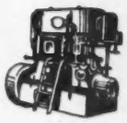

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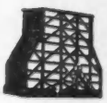

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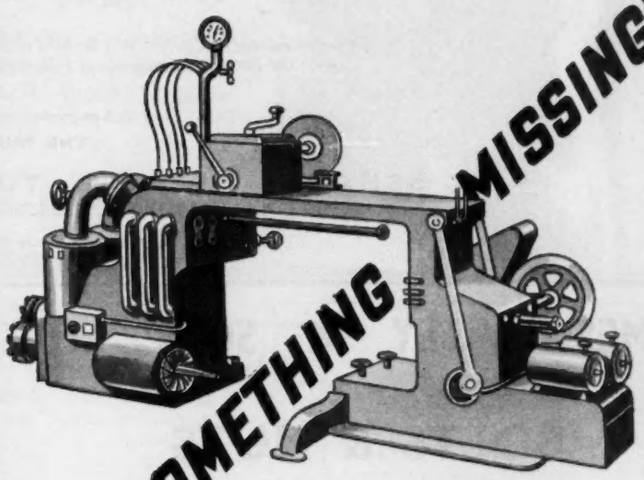

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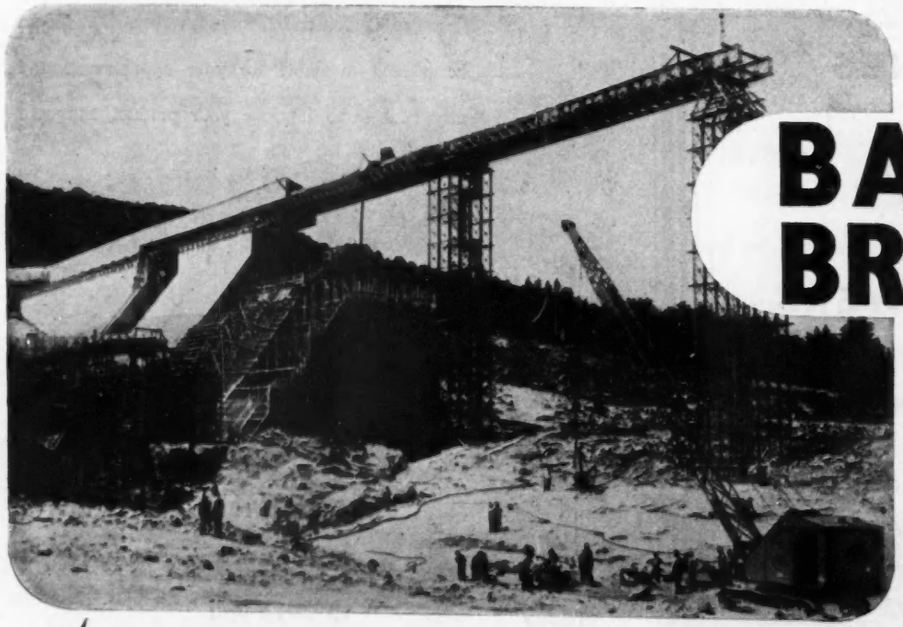

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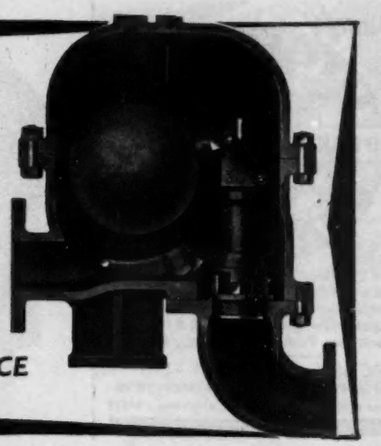

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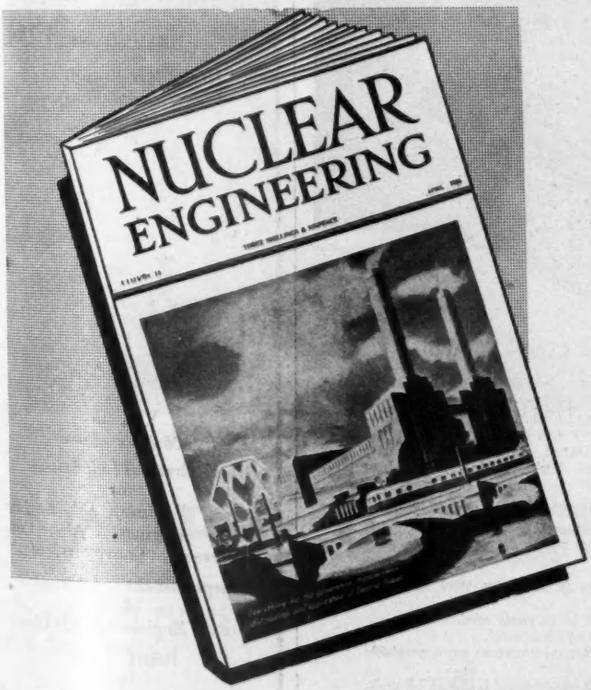

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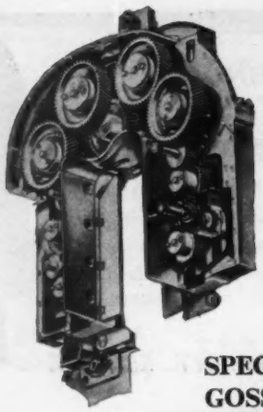

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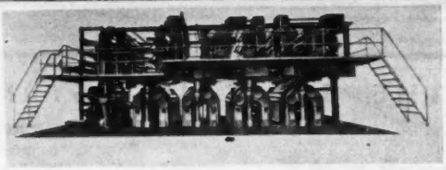

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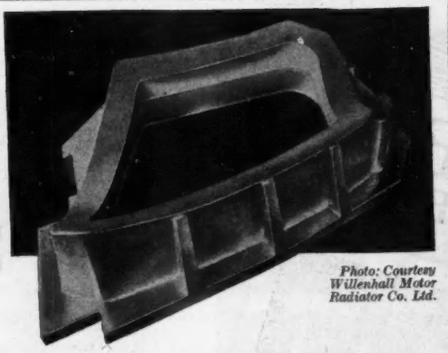

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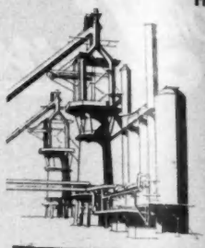

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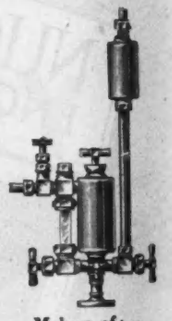

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6½ miles of BTR CONVEYOR BELTING at Barking

BTR Conveyor Belting, 6½ miles of it, is the backbone of the highly versatile and flexible conveying system at Barking Generating Station. For Barking is three stations in one, and the system discharges 4000-ton colliers in under eight hours, stocks or draws from the coal stores as required, and continuously feeds the various boilerhouses each with its own type of coal.
All this is achieved by strong, tough, and precision-built BTR belts travelling at 600 ft or more per minute over this comprehensive network of main, shuttle, and bridge conveyors, moving coal at the rate of 800 tons an hour. The 2200 ft emergency coal store reversible conveyor for example, reputedly the longest in the country, is a real test of belt manufacturing standards; for to run true on such a conveyor, a belt must be precision-built indeed. BTR Belting is the backbone of Barking coal handling efficiency—make it the backbone of yours.

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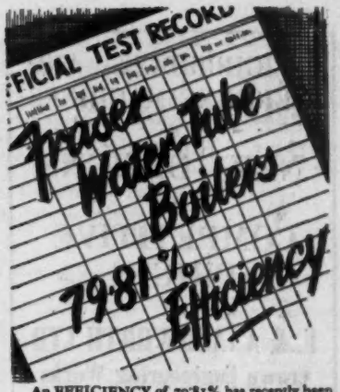
BRITISH TYRE & RUBBER CO. LTD., HERGA HOUSE, VINCENT SQUARE, LONDON S.W.1



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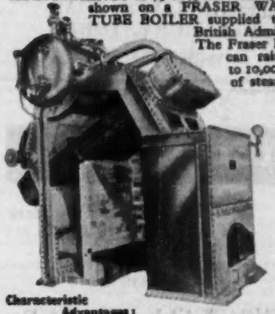

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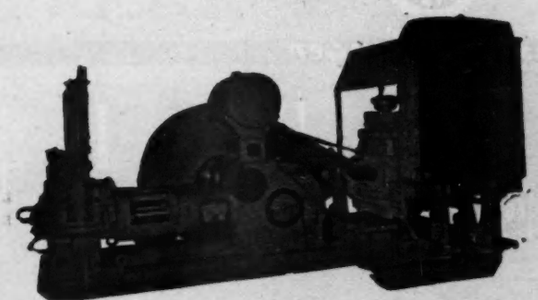

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Designers and Builders of Steam, Diesel and Diesel-electric Locomotives

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THE BEST OF HAUL INVESTMENTS

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for economy, accuracy, reliability

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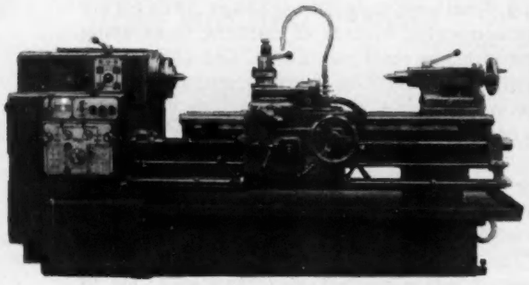
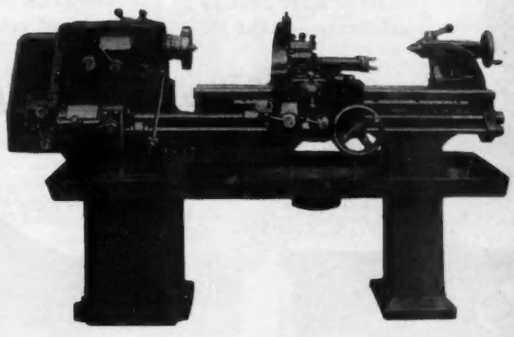


Model '85'
8½" centre lathe

Model '70' junior
7" centre lathe



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WAKEFIELD ROAD BRIGHOUSE
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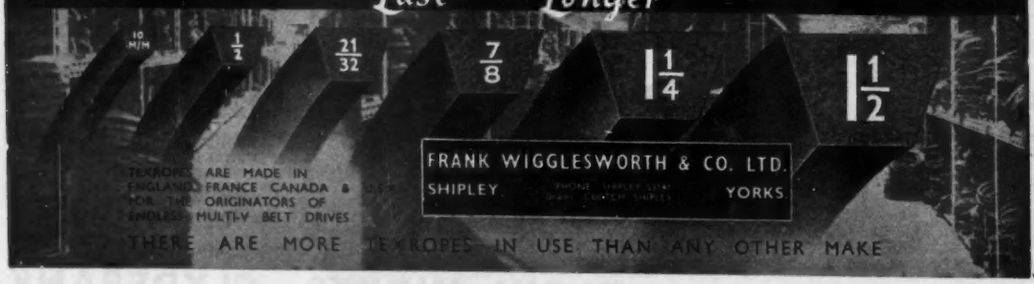
For new drives for Replacements
TEXROPE V-BELTS
Last Longer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FRANK WIGGLESWORTH & CO. LTD.
SHIPLEY YORKS
TEXROPES ARE MADE IN ENGLAND FRANCE CANADA & U.S.A. BY THE ORIGINATORS OF ENDLESS MULTI-V BELT DRIVES
THERE ARE MORE TEXROPES IN USE THAN ANY OTHER MAKE

ASK FOR PRICES

WIGGLESWORTHS
the originators and largest makers of V-belt drives in this country.

Classified Advertisements continued from Page 8

DRAUGHTSMEN, with O.N.C. or H.N.C. in mechanical engineering, are required for various departments at Fort Dunlop. There are exceptionally good opportunities for those interested in plant layout, factory services, special-purpose machine design or tyre design.—Please write, giving age, experience, and salary required, to PERSONNEL MANAGER, DUNLOP RUBBER CO., LTD., FORT DUNLOP, ERDINGTON, BIRMINGHAM. K 382

ELECTRICAL DEVELOPMENT ENGINEER required with technical and practical experience of all branches of electrics applicable to aircraft. Must be willing to accept full responsibility and be qualified to carry out an extensive programme of test work and analysis of results. A commensurate salary will be paid.

Full particulars in writing to the CHIEF ENGINEER, THE FAIREY AVIATION CO., LTD., HAYES, MIDDLESEX. K 308

Draughtsmen, Draughtswomen and Tracers — Mechanical Engineering.

For Engineering Consultants. Positions are permanent, pensionable, with five-day week. Free lunches. Basic Salary above A.E.S.D. minimum rates, plus profit sharing scheme.

Phone or write, giving details of previous experience, to the

PERSONNEL OFFICER, EWBANK & PARTNERS, LTD., 10/11, GROSVENOR PLACE, LONDON, S.W.1. 200 YARDS HYDE PARK CORNER. SLOANE 0486. G 630

STRUCTURAL ENGINEER.
Chief Draughtsman for Branch Office in London. Experienced man, fully qualified to take responsibility for design and detail office covering a wide range of steel construction.—Apply, furnishing details of experience and salary required, to MANAGER, TECHNICAL SERVICES, WRIGHT ANDERSON & CO., LTD., GATESHEAD, 8, CO. DURHAM. K 465

PIPING DRAUGHTSMEN required by ASHMORE, BENSON, PEASE & COMPANY, STOCKTON-ON-TEES, experienced in the layout and detailing of requisite pipework for Chemical, Gas, Oil and similar type work. Maximum assistance given in obtaining accommodation. Appointments are permanent by firm where Pension Scheme, Technical Library, Sports and Social facilities have long been in operation.—Apply stating age, experience, etc., quoting Ref. P.F. K 175

PETTERS LIMITED require
ENERGETIC AND EXPERIENCED SALESMAN for overseas travelling. Engineering background, preferably diesel, essential. Languages, notably Spanish, an advantage. Candidates should be in good health and be prepared to spend nine months of the year abroad. Salary commensurate with ability and qualifications.

Apply, giving full personal particulars to CHIEF PERSONNEL OFFICE, PETTERS LIMITED, CAUSEWAY WORKS, STAINES, MIDDX. K 423

Expanding engineering company near Lake District offers good scope to

A DRAUGHTSMAN prepared to use initiative in the design and development of either coal mining machinery or earth moving machinery. Previous experience of these kinds of machinery is desirable but experience of medium or heavy general engineering may be acceptable. Good conditions. Pension scheme. Assistance with housing.—APPLY DISTINGTON ENGINEERING COMPANY, LIMITED, P.O. BOX 8, WORKINGTON, CUMBERLAND. K 377

RAILWAY ROLLING STOCK BUILDERS

require

A MAN HAVING EXPERIENCE IN THE PRODUCTION OF RAILWAY CARRIAGE AND/OR WAGONS and in the handling of labour matters as assistant to the Works Manager. The position holds good prospects and carries a salary commensurate with the responsibility. Birmingham Area, house available. Applications with full details of training and experience to BOX K 472, Offices of ENGINEERING.

METALLURGIST (QUALIFIED) required for light engineering works in West London for fundamental research work on the heat treatment of steel. Salary—up to £1000 per annum according to qualifications.—BOX K 339, Offices of ENGINEERING.

Advertiser requires
METALLURGIST (QUALIFIED) for light engineering works in West London for process control and development work. Salary—up to £1000 p.a. according to qualifications.—BOX K 340, Offices of ENGINEERING.

GRADUATE ENGINEERS (MECHANICAL) required immediately for a progressive Chemical Industry located in the North of England.

These vacancies are for design work in the Chief Engineer's Department and are of special interest to young engineers with a flair for design and development work who have served a Graduate Apprenticeship.

The age range is 26-33 and the salary within the range of £1000-£1500 depending upon age, qualifications and experience. There is a scheme for assisting married men with house purchase and removal expenses. Annual bonus and Pension Schemes are attractive.

Applications, which will be treated in the strictest confidence to BOX K 295, Offices of ENGINEERING.

A well-known engine manufacturer has vacancies for **ENGINEERS** with experience of the installation of diesel engines up to 2000 h.p. for rail traction and marine purposes. The duties include the handling of technical problems in connection with customer's installations with the supervision of the drawing office work involved, and applicants should have had previous drawing office and practical experience on this class of work.—Applications, which will be treated in strict confidence giving age, qualifications, experience and salary required should be addressed to Chief Engineer, BOX K 461, Offices of ENGINEERING.

SENIOR DRAUGHTSMEN

YARROW & CO. LTD., SCOTSTOUN, require several senior marine engine draughtsmen; experience in machinery layout and pipe arrangements in naval vessels or small ships essential. There are vacancies also for senior men with experience in marine water tube boiler design. The posts are pensionable. Write stating age and previous experience. K 406

MANAGEMENT CONSULTANTS.

Steady growth of the United Kingdom affiliate of MEAD CARNEY INTERNATIONAL CORPORATION of New York has created staff openings at senior and intermediate levels for the **CONSIDERATION OF MEN WITH A SOLID BACKGROUND** of consulting management engineering experience and capable of earning £2500 a year and upwards.

Appointments for interview will ONLY be granted upon the prior submission of written applications and details both of work experience and personal history of a relevant nature must be included.

Confidential applications should be addressed to COLWELL J. CARNEY, CHAIRMAN, MEAD CARNEY & COMPANY, LTD., 42, HILL STREET, MAYFAIR, LONDON, W.1. K 376

CHIEF ENGINEER FOR TURBINE TANKER

Wanted. Chief Engineer for new 25,000 tons d.w. Turbine Driven Tanker, now fitting out at Middlebrough. Good salary and conditions offered to a capable engineer, reply fully to :

Superintendent Engineer,

Stevinson, Hardy & Co. Limited,
155, Fenchurch Street,
London, E.C.3.

K 313

MANAGING DIRECTOR—Leading British Company with head offices in London requires managing director for one of its subsidiary companies located in the London area. The appointment calls for a first class commercial and technical executive with many years' experience in the iron and steel, metallurgical and chemical industries. The appointment will carry a salary in a range of £4000/£6000 and applications will only be considered from first class executives between the ages of 35/50 years whose experience clearly indicates that they are capable of taking full control of a company with a turnover of several million pounds per annum. Applications will be treated strictly as private and confidential and should be addressed to BOX K 380, ENGINEERING.

CIVIL AND STRUCTURAL ENGINEERING DESIGNERS, DRAUGHTSMEN AND STRUCTURAL CHECKERS required for Consultants Offices in Bristol and elsewhere in England and Wales. Must be experienced in one or more of the following: Structural Steelwork for buildings and material handling plants, Reinforced Concrete, Pipework and General Building Construction. Five-day week, optional pension scheme, good salaries and opportunities for promotion by merit.—Reply stating age, experience and qualifications to BOX K 291, Offices of ENGINEERING.

BRITISH PETROLEUM COMPANY, LIMITED, has immediate vacancies for
CHEMISTS, PHYSICISTS, CHEMICAL ENGINEERS AND MECHANICAL ENGINEERS for work in their United Kingdom Refineries and at their Research Station at Sunbury-on-Thames. Applications are invited from men with University degrees or equivalent qualifications and who have fulfilled National Service obligations. Previous Industrial experience desirable but not essential. Age preferably not above 33. Salaries within the range £650-£1300 according to qualifications and experience. Excellent working conditions. Non-contributory Pension Scheme.—Write, giving 565 details quoting H.3297 to BOX 8580, c/o full. GRESHAM HOUSE, E.C.2. G 565

SAFETY OFFICER. A large firm of Engineers specialising in the erection of heavy industrial plant and civil engineering construction requires the services of a Safety Officer. The post involves control of the accident prevention work on contract sites in the U.K. An engineering background is essential and technical qualifications would be an advantage. Candidates should have had previous experience of safety work and must be fully acquainted with the application of the Factories Act and Statutory Regulations. Only candidates who can fulfil these requirements will be considered and a commensurate salary will be paid to the right man. An interview in confidence will be arranged with suitable candidates and full details of duties, responsibility, etc., will be explained. The post is superannuable. The successful candidate will operate from an office in the North of England but travelling to sites is necessary.—Please write full details to BOX K 366, Offices of ENGINEERING.

THE AERODYNAMICS DEPARTMENT OF ARMSTRONG SIDDELEY MOTORS has vacancies for both
SENIOR AND JUNIOR DEVELOPMENT ENGINEERS for work on axial flow compressors, turbines and general airflow. A Degree in Mechanical Engineering and previous experience in this type of work an advantage. Initial salaries range from £650 to £1050 per annum, dependent on age, experience and qualifications but superscale rates would apply to senior experienced men. Excellent prospects and good pension fund.—Applicants should give full details quoting Reference Airflow 2, to TECHNICAL PERSONNEL MANAGER, ARMSTRONG SIDDELEY MOTORS, COVENTRY. G 625

QUANTITY SURVEYOR required by Consulting Engineers in Birmingham. Staff pension scheme. Please reply in confidence giving qualifications, previous experience, age, etc., to BOX No. 295, GLOVERS ADVERTISING LIMITED, 351, OXFORD STREET, LONDON, W.1. G 595

Vacancies exist in the Works Engineer's Department of a large company in East London for
PERSONNEL CAPABLE OF DRAWING AND PLANNING LAYOUTS for both Machine and Assembly Shops from information supplied by Time Study Departments, also experience in Ventilation and Extraction Systems, Palletisation and Mechanical Handling of Stores, etc. Age between 30 and 40. A salary of up to £750 will be paid to the selected candidates. Please write, giving details of experience to BOX K 450, Offices of ENGINEERING.

RESEARCH ENGINEER OR PHYSICIST

with advanced knowledge of thermodynamics required by a Glasgow Engineering Company. Applicants, aged 25-30, should have a University Honours Degree. Experience in heat transfer problems would be an advantage. Salary depending on qualifications and experience.—Apply to BOX G 585, Offices of ENGINEERING.

AFRICAN EXPLOSIVES AND CHEMICAL INDUSTRIES LIMITED

Applications are invited for appointments at the Factories and Research and Consulting Engineer's Departments of the above mentioned Company in the Union of South Africa.

The Company's three main Union factories are located near Johannesburg, Cape Town and Durban respectively.

Vacancies exist for :—

(1) **PLANT AND LABORATORY CHEMISTS** with Chemistry or Chemical Engineering qualifications.

(2) **RESEARCH CHEMISTS** with post-graduate qualifications in Chemistry or Physics.

(3) **MECHANICAL AND ELECTRICAL ENGINEERS,** preferably with not less than two years experience since graduation

(4) **INSTRUMENT ENGINEERS** with Electrical (Light Current) or Chemical Engineering qualifications and maintenance and/or design experience in industrial instrumentation.

Further information and application forms can be obtained from H. W. AHRENS, AFRICAN EXPLOSIVES & CHEMICAL INDUSTRIES LIMITED, IMPERIAL CHEMICAL HOUSE, MILLBANK, LONDON, S.W.1. G 634

BRITISH PETROLEUM COMPANY LIMITED requires
ENGINEERS OR PHYSICISTS with University Degrees, for experimental work on internal combustion engines including gas turbine engines and motor vehicle engines of high performance. Previous practical experience is not essential, but applicants should have a keen interest in this type of work. Age preferably not above 33. Salaries within the range £650 to £1300 per annum, according to qualifications and experience.—Write, giving full details, quoting H.3299, to BOX 8565, c/o 191, GRESHAM HOUSE, E.C.2. G 638

West End London Consulting Engineers require now **SEVERAL SENIOR AND JUNIOR ENGINEER DRAUGHTSMEN** to prepare designs, contract drawings, specifications, etc., for heating, ventilating, boiler plant and allied mechanical services. Interesting work for factories, office blocks, hospitals, colleges, schools, etc. Opportunity for experienced men with initiative. Five-day week. One week's spring holiday in addition to usual summer two weeks. Bonus and optional superannuation scheme.—Write stating age, experience, qualifications and salary required. BOX G 538, Offices of ENGINEERING.

BRITISH PETROLEUM COMPANY LIMITED has a vacancy for a
STATISTICIAN in the Physics Section at its Research Station at Sunbury-on-Thames. Applications are invited from men who have completed a degree course in Statistics or who have had equivalent experience. Work will be on statistical problems in the oil industry including statistical design of experimental programmes. Applicants should be capable of co-operating fully with Research Staff and of ensuring that statistical techniques are used to the best advantage. Knowledge of the oil industry is not an essential. Excellent working conditions. Non-contributory Pension Scheme and Luncheon Club facilities. Write giving full details, quoting H.3308, to BOX 8207 c/o 191, GRESHAM HOUSE, E.C.2. G 597

Classified Advertisements continued on Page 86

WANTED

DRAUGHTSMEN to design in aluminium for sales development. Must possess Higher National Certificate in Mechanical Engineering. Location Banbury. Good working conditions and pleasant surroundings. Attractive starting salaries offered up to £800 p.a. with prospects of promotion from drawing board. Pension plan in operation. Send brief details of qualifications and experience to NORTHERN ALUMINIUM CO. LTD., BUSH HOUSE, ALDWYCH, LONDON, W.C.2. G 562

DRAUGHTSMEN (SENIOR AND JUNIOR) required for work in connection with the following branches of Coke Oven and Gasworks plants.

(a) Mechanical and By-Product Plant.
(b) Pipework.
(c) Steelwork for Buildings and Conveyors.

Applicants should be competent men able to work with the minimum of supervision. Technical qualifications to O.N.C. or beyond. Good remuneration and prospects for capable men. Pension scheme. Five-day week; Canteen Facilities.—State age and experience to the PERSONNEL OFFICER (D.O.), WOODALL-DUCKHAM CONSTRUCTION COMPANY LTD., WOODALL-DUCKHAM HOUSE, 63-77, BROMPTON ROAD, LONDON, S.W.3. G 550

STRUCTURAL ENGINEER with wide experience of the design and detailing of all types of steel structures and with administrative experience required to act as deputy to the Chief Engineer by large firm of London Consultants. The firm is expanding and the vacancy offers excellent opportunities for the right type of man.—Write in confidence giving details of previous experience and salary required to BOX No. 355, GLOVERS ADVERTISING LTD., 351, OXFORD STREET, LONDON, W.1. G 635

ASSISTANT CIVIL ENGINEERS required for immediate posts in Scotland. Positions are long term and carry opportunities where desired for work in London and later abroad. Assurance and staff pensions. Categories required:—

(a) Graduates qualifying in 1956, who desire opportunity to complete requirements for Associate Membership of the Institution of Civil Engineers.
(b) Associate Membership of the Institution of Civil Engineers or similar standard for either design or site supervision.

BOX G 644, Offices of ENGINEERING.

DESIGNER DRAUGHTSMEN AND JUNIORS required by Concrete Specialists for both Pre-stressed and Reinforced Concrete work. Excellent prospects for the right man, attractive salary, pension scheme and sports club facilities. Apply in writing giving age, and full particulars of training and experience to the PERSONNEL MANAGER, PIERHEAD ENGINEERING DIVISION, THE UNIT CONSTRUCTION CO., LTD., 34, ST. JAMES'S STREET, LONDON, S.W.1. G 645

GRADUATE ENGINEERS FOR CONSTRUCTION

Applications are invited for the following position with Major Oil Company Middle East.

(1) ENGINEERING ASSISTANT TO CONSTRUCTION SUPERINTENDENT (CIVIL OR MECHANICAL ENGINEER) with over five years experience field engineer construction process plant, industrial and general building projects. Familiar field organisational problems and with good working knowledge general construction and equipment. Age 30-40. Commencing salary £1580 p.a. up according experience, etc.

(2) FIELD ENGINEERS (4) (CIVIL OR MECHANICAL) with over two years experience in either general building projects such as housing, public buildings and utility installations or in oil refinery or chemical process plant installation and utilities. Must be familiar with job planning, scheduling and general construction techniques. Age about 30. Commencing salary £1245 p.a.

In addition to salaries quoted, free air conditioned accommodation and adequate living allowance provided with medical attention, kit allowance, pension plan and paid home and local leaves.—Apply (quoting CON) to BOX G 647, Offices of ENGINEERING.

ENGINEERS (MECHANICAL)

SENIOR AND JUNIOR required for work on capital projects. Minimum qualifications: Senior, Corporate Membership of Institution of Mechanical/Chemical Engineers and/or University Degree, Junior, H.N.C. Mechanical/Chemical Engineering. Preference will be given to suitable candidates with chemical and supervisory experience. Permanent positions for suitable applicants with good prospects, salary and pension scheme.—Applications, which will be treated confidentially, should state age, qualifications, experience in chronological order, present remuneration and be addressed to PERSONNEL MANAGER, BRITISH ENKA LIMITED, AINTREE, LIVERPOOL, 9. K 875

TRANSFORMER SPECIALIST ENGINEER required for a Senior Sales Post in a progressive Company. The man appointed should possess at least an H.N.C. (Electrical) and preferably be a corporate member of the I.E.E. He should have recent experience on the design of transformers up to 45 mVA, 132 kV and possess the qualities of personality necessary in a first class sales engineer. For the right man there are excellent prospects of promotion to top Management positions in an expanding organisation. Terms of employment include staff bonus and generous non-contributory superannuation.—Please apply to CHIEF PERSONNEL OFFICER, BRUSH ELECTRICAL ENGINEERING CO., LTD., LOUGHBOROUGH, LEICS. K 940A

SERVO CONTROL DRAUGHTSMEN AND TRAINEES

required for the design of Industrial Electronic and Magnetic Amplifiers for Servo Mechanisms in connection with Electrical Motor Control Gear and associated equipment. Previous experience in this class of work preferred, but not essential. Experienced Draughtsmen on electrical and/or mechanical work are invited to apply.

Draughtsmen are also required for the preparation of wiring diagrams.

Trainees, of not less than S.2, O.N.C. standard or those who are now taking S.2 will be considered for all of the above. The positions are permanent and the work offers excellent opportunities.

Pension Scheme in operation.
Full canteen facilities.
Apply for application form, quoting reference "T.4," to:—

PERSONNEL MANAGER,
METROPOLITAN-VICKERS ELECTRICAL CO., LTD.,
TRAFFORD PARK, MANCHESTER, 17.

K 862

BRITISH THOMPSON-HOUSTON COMPANY, LTD.

There are vacancies in the Valve Engineering Department for work connected with the engineering and development of semi-conductor devices. Those with qualifications (H.N.C. and above) in Electrical Engineering or Physics are wanted for development projects involving transistors and rectifiers; an interest in radio would be an advantage. Qualified mechanical Engineers (H.N.C. and above) are needed to design and develop jigs and automatic machines for device manufacture.

Applicants are invited to write to the HEAD OF THE VALVE ENGINEERING DEPARTMENT (367289-1), BRITISH THOMSON-HOUSTON CO., LTD., LADYWOOD WORKS, LUTTERWORTH, NR. RUGBY, giving details of their age, qualifications and experience. K 374

CHEMICAL ENGINEERING COMPANY in Westminster district has a vacancy for a **TECHNICAL AND SALES ENGINEER.** Qualifications are: age about 25-30, B.Sc. standard good knowledge physics, heat exchange essential and chemistry desirable. Understanding of general office procedure an advantage. The position offers an excellent opportunity for a man having these qualifications, coupled with a keen business outlook. Write stating fullest possible particulars, including age, qualifications and salary required to BOX K 390, Offices of ENGINEERING.

MECHANICAL AND ELECTRICAL SERVICES ENGINEER required by Consulting Engineers in Birmingham. Permanent post with pension scheme.—Reply in confidence giving qualifications, previous experience, age, etc., to BOX No. 300, GLOVERS ADVERTISING LTD., 351, OXFORD STREET, LONDON, W.1. G 596

DESIGN DRAUGHTSMAN required in Cambridge for interesting work on agricultural spraying machinery. Must have good all-round mechanical engineering knowledge and be free from Military Service. Five-day week. Pensionable post.—Write (Quoting No. 1184), stating age, qualifications, experience and salary required, to PERSONNEL MANAGER, FISONS PEST CONTROL LIMITED, BOURN, CAMBRIDGE. K 370

Large modern company of mechanical engineers in North West require a **TECHNICAL ENGINEER,** member of professional association, with wide practical experience in manufacturing methods, machine tools, processes and design. He will control about 80 staff. Chief responsibility will be the planning of production and full exploitation of manufacturing potential. Preferred age limit, 35 to 45.

This is a salaried pensionable executive post.—BOX K 371, Offices of ENGINEERING.

Leading manufacturers of container closures in the Midlands have a number of vacancies for ambitious **DESIGN DRAUGHTSMEN** preferably with some experience in this or a similar sphere. Interesting work with excellent salary and every opportunity for promotion to senior position in a rapidly growing organisation. Write in confidence with details of experience, positions held, salary required; to P. A. METAL CLOSURES LIMITED, BROMFORD LANE, WEST BROMWICH. G 627

NEW RESEARCH LABORATORY

IMPORTANT APPOINTMENTS

Powers-Samas Accounting Machines, Ltd. (one of the Vickers Group of Companies) is expanding the resources of its Research Division for the development of electronic data processing equipment, punched-card machines and allied devices. A new Research Laboratory is under construction at Caterham, Surrey—and until its completion the staff appointed will work at existing establishments in Croydon and Crayford, Kent.

The appointments offered provide scope for both senior and junior staff. Salaries will be competitive and in accordance with qualifications and experience. Applications are invited from:—

1. Honours graduates in physics or engineering for a wide range of research and development work on electronic computors and associated equipment.

2. Engineers with Higher National Certificate for development and design work on electronic computors and associated equipment.

3. Juniors possessing evidence of the necessary scholastic and technical ability who wish to continue with studies for higher qualifications.

Applications, with details of previous experience and qualifications, should be sent to THE PERSONNEL MANAGER, POWERS-SAMAS ACCOUNTING MACHINES, LTD., CROYDON. G 628

CHIEF ENGINEER
required by
substantial general Engineering Company
SLOUGH.

Responsibility design, development, product engineering.

Only first-class qualified men considered.

Salary £2000 plus.

Write in confidence, stating age and experience to MANAGING DIRECTOR, BOX E.G.648 c/o 191, GRESHAM HOUSE, E.C.2.

K 268

TEXTILE MILL requires
ASSISTANT TO CHIEF ENGINEER

25-35 years of age with University degree or equivalent in Mechanical Engineering with experience in similar position, to take charge of maintenance shops, electrical installation, drawings records. Permanent position with good prospects. Salary commensurate with qualifications. Pension scheme. Only first-class men need apply, stating age, qualifications, experience and salary required to:—

MANAGING DIRECTOR,
BRITISH DEPA CREPES LIMITED,
GLEBE MILLS,
HOLLINGWOOD, OLDHAM, LANCS.

K 880

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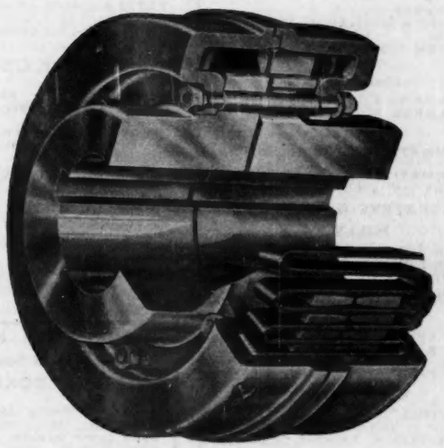

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Application forms may be obtained from the SECRETARY, DEPARTMENT OF CHEMICAL ENGINEERING, TENNIS COURT ROAD, CAMBRIDGE, and should be completed and returned by 21 April, 1956.

K750

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K751

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

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NOTICE IS HEREBY GIVEN that a number of English Electric Company Bursars in Hydro-Power Engineering will be elected in June 1956. The Bursaries are of the value of £460 for one year tenable for postgraduate study in the Civil Engineering Department of the Imperial College. Bursars pay the appropriate College Tuition Fee.

Bursars who successfully complete the course will be eligible for the award of the Diploma of the Imperial College (D.I.C.)

Candidates should have an Honours Degree in Engineering or an equivalent qualification, and applications should be received before 1st June 1956, by the DEPUTY REGISTRAR, CITY & GUILDS COLLEGE, EXHIBITION ROAD, LONDON S.W.7, from whom further details may be obtained.

K.643.

UNIVERSITY OF CAMBRIDGE

SHELL

CHEMICAL ENGINEERING STUDIES FUND

The Managers of the Shell Chemical Engineering Studies Fund invite applications for a grant to enable the selected applicant to read for the Chemical Engineering Tripos of the University of Cambridge. Applicants should be persons resident in Great Britain or Northern Ireland who hold or expect to hold a University degree with high honours in chemical engineering or in some other branch of engineering or in pure science. The grant will be of £425 a year for two years and will be made conditional on the selected applicant becoming a member of the University.

Further particulars and application forms may be obtained from the SECRETARY, DEPARTMENT OF CHEMICAL ENGINEERING, TENNIS COURT ROAD, CAMBRIDGE, and should be completed and returned by 18.May.1956.

K.752.

PUBLIC APPOINTMENTS.

UNIVERSITY OF BRISTOL

FACULTY OF ENGINEERING.

Applications are invited for TWO LECTURESHIPS IN THE DEPARTMENT OF MECHANICAL ENGINEERING. The salary will be in the range of £550 to £1350, with family allowances and F.S.S.U. membership; initial salary will depend on age and qualifications. Applicants should have good academic qualifications and practical experience. Further particulars may be obtained from the Registrar, the UNIVERSITY, BRISTOL, 8.with whom applications should be lodged before 30th April 1956. K.706.

BRISTOL EDUCATION COMMITTEE

COLLEGE OF TECHNOLOGY

PRINCIPAL:
G.H.Moore, M.Sc., F.P.S., F.R.I.C.

Applications invited for post of Assistant Grade B, vacant May 1st , to teach Mechanical Engineering subjects in National Certificate and Diploma Courses.

Application form, (returnable within two weeks) and further particulars by sending stamped addressed envelope to REGISTRAR, COLLEGE OF TECHNOLOGY, UNITY STREET, BRISTOL. 1.

G.H. SYLVESTER
Chief Education Officer.

K808

WORK WANTED.

"DRAWINGS WITH TENDER?" Why not. Isometric Lay Out giving comprehensive illustration of exact proposals.—Apply BOX K 429, Offices of ENGINEERING.

B.C.S.

ONE—600 K.W. SULZER DIESEL GENERATING SET, 220/440 volts, D.C. complete with Auxillaries, Spares, etc.
ONE—850 K.W. SULZER DIESEL ALTERNATOR SET 400/440 volts, 3 phase, 50 cycles

STAINLESS STEEL available, ex-stock. Sheets, Bars, Tubes and Angles. Send for our priced Stock List.
THE MULBERRY COMPANY,
223, St. John Street, London, E.C.1.
Telephone: CLErkenwell 8356-7-8. G 455

UNIVERSITY OF ST. ANDREWS
QUEEN'S COLLEGE, DUNDEE
LECTURESHIP IN ENGINEERING

Applications are invited for appointment as LECTURER IN MECHANICAL ENGINEERING in the Department of Civil and Mechanical Engineering, Queen's College, Dundee, to commence 1st October 1956. The candidate appointed would be required to assist with the teaching and to take part in the research work of the Department. Opportunities will be granted to work for a higher degree. Salary scale, £650 x £50 per annum to £1,350, with efficiency bar at £1000 and commencing salary according to experience and qualifications. F.S.S.U. and Family Allowance benefits; a grant towards expenses of removal may be made. Six copies of the application, which should contain the names of three referees to the undernoted, not later than 18th April, 1956.

PATRICK CUMMING,
Joint Clerk to the University Court,
Queen's College, Dundee.
K.493

BRADFORD EDUCATION COMMITTEE

TECHNICAL COLLEGE

BRADFORD

Applications are invited for the appointment of ASSISTANT (GRADE B) IN CIVIL ENGINEERING in the College. A knowledge of Geology and Soil Mechanics would be an advantage.

The salary, including allowances, may range from £525 to £964 per annum for men, according to the Burnham Scale. The commencing salary will depend upon qualifications and experience, and may be increased up to a maximum of 12 increments of £18 per annum in respect of approved service in industry

Further particulars of the appointment and forms of application may be obtained from the Director of Education, Town Hall, Bradford 1, and completed forms should be returned to the Principal of the College as soon as possible.

A.SPALDING
Director of Education. K.756

CITY OF WAKEFIELD

EDUCATION COMMITTEE

WAKEFIELD TECHNICAL COLLEGE.

Applications are invited for the post of GRADE A ASSISTANT to teach ENGINEERING WORKSHOP SUBJECTS. Good workshop experience and suitable qualifications required, e.g. Final City and Guilds Certificate in Machine Shop Engineering. Ability to teach elementary science or mathematics would be an additional recommendation.

Application forms, obtainable from the Education Offices, 27, King Street, Wakefield, should be returned within fourteen days of the appearance of this advertisement.

C.L. BERRY,
Director of Education.

Education Department, K689
27, King Street,
WAKEFIELD.

BEDFORDSHIRE EDUCATION COMMITTEE

LUTON COMMITTEE FOR EDUCATION

LUTON AND SOUTH BEDFORDSHIRE COLLEGE

OF FURTHER EDUCATION

Principal:
W.F. Stephenson, B.Sc., F.R.I.C.

Applications are invited for the following posts in the Department of Engineering, duties to commence on 1st September, 1956:-

LECTURER - MECHANICAL ENGINEERING
Candidates must be honours graduates in Mechanical Engineering. Duties will include teaching to students in B.Sc. (Eng.) and Higher National Certificate Courses, and candidates should offer two subjects to this level, one of which should be Theory of Machines. Opportunities for research are available.

Salary will be in the range £965 x £25 - £1,065.

ASSISTANT GRADE B - MECHANICAL ENGINEERING.
Candidates must be honours graduates in Mechanical Engineering. Duties will include teaching up to the standard of B.Sc.(Eng.) and Higher National Certificate. Opportunities for research are available.
Salary will be in the range £525 x £25 - £820 with appropriate additions for qualifications, industrial and teaching experience.

Send s.a.e. (foolscap) for application form, which should be returned within ten days of the appearance of this advertisement, to
J.A. CORBETT, CLERK OF THE GOVERNORS,
63/69 GUILDFORD STREET, LUTON.
K693

STAFFORDSHIRE EDUCATION COMMITTEE

Leek College of Further Education

Principal: E.Lansley, B.Sc. (Econ)

Applications are invited for the following full-time teaching appointment:-

ASSISTANT GRADE A TO TEACH ENGINEERING SUBJECTS up to S.1 level. These include Mathematics, Technical Drawing, Engineering Science and Workshop Technology including practical work, which are taken by full-time and day release students.

Salary in accordance with the Burnham (Technical) Scale, Grade A, £450 x £18 - £702 x £23 - £725 plus allowances for degree and approved training.

Form of application, returnable within 14 days of this advertisement and further particulars may be obtained from the undersigned on receipt of a stamped addressed foolscap envelope.

J.H.P. OXSPRING,
Director of Education.

Dept. F.E.,
County Education Offices,
Stafford. K.667

CARMARTHENSHIRE EDUCATION COMMITTEE

LLANELLY TECHNICAL COLLEGE

Applications are invited for the following vacancies at the above-named College:-

(1) FULL-TIME ASSISTANT MASTER IN MECHANICAL ENGINEERING.

(2) FULL-TIME ASSISTANT MASTER IN PRODUCTION ENGINEERING

Candidates should be graduates in Engineering, or be Corporate Members of the Institution of Mechanical or Production Engineers, respectively, with industrial experience, and preferably some teaching experience.

Salary in accordance with the Burnham Further Education Report, 1954, for Grade B Assistants, including allowances for teaching and approved industrial experience.

Duties to commence as soon as possible.

Further particulars and forms of application, which must be returned within TWO weeks of the appearance of this advertisement, may be obtained from the undersigned on receipt of a stamped addressed envelope.

IORWERTH HOWELLS

DIRECTOR OF EDUCATION.

County Education Offices,
County Hall
Carmarthen. K.666

CITY COUNCIL OF SINGAPORE

WATER DEPARTMENT

Applications are invited for Appointment of a TEMPORARY CONSTRUCTION ENGINEER. Applicants must be Corporate Members of the Inst. C.E., and have extensive experience in the construction of earth dams on soft foundations and should have experience in sheet piling, cofferdams, de-watering, flood diversion by tunnelling or channelling, heavy and deep excavation formation and compaction of clay and rock fill embankments, construction of heavy reinforced and mass concrete overflow bottom outlet and intake structures, grouting of rock foundations and investigation by boring, and the consolidation of earth fill.

Static inclusive salary $2,000 per mensem (£2,800 per annum) and free quarters with hard furnishings. The appointment is on a 3 years' contract. 28 days full pay leave per annum on satisfactory completion of contract. Free return 1st Class air passages for officer, wife and family suject to certain limits. Salary at half rate for the period of direct flight out to Singapore and on the return direct flight to the United Kingdom.

Further details from the COUNCIL'S LONDON AGENTS: MESSRS ALLEN & WILLIAMS, 1 VICTORIA STREET, WESTMINSTER, LONDON S.W.1. Closing date for full applications in DUPLICATE, Thursday April 12th, 1956. K.670

LONDON: HARRISON & SONS, LTD., by Appointment to Her Majesty The Queen, Printers, London, Hayes (Middx.), and High Wycombe, and Published by ENGINEERING Ltd., Proprietors of ENGINEERING, at 35 & 36, Bedford St., Strand, London, W.C.2.

CITY OF SHEFFIELD EDUCATION COMMITTEE

COLLEGE OF COMMERCE AND TECHNOLOGY

Applications are invited for the following full-time posts, duties to commence as soon as possible.

(a) SENIOR LECTURER IN MECHANICAL ENGINEERING to teach students preparing for Higher National Certificate and to assist in the organisation and supervision of these courses. Candidates should hold graduate or equivalent qualifications, and be able to offer a selection of subjects from strength of Materials, Applied Mechanics, Metrology and Machine Tools.

(b) SENIOR LECTURER IN MECHANICAL ENGINEERING to teach students preparing for Higher National Certificate and to assist in the organisation and supervision of these courses. Candidates should hold graduate or equivalent qualifications, and be able to offer a selection of subjects from Theory of Machines, Applied Mechanics, Applied Thermodynamics, Applied Heat and Plant Engineering.

(c) ASSISTANT GRADE B (MECHANICAL ENGINEERING) to teach classes in a selection from Engineering Drawing and Science, Applied Mechanics and Applied Heats; ability to teach Calculations and Drawing for Electrical Installation Work would be an advantage.

(d) ASSISTANT GRADE A(MECHANICAL ENGINEERING) to teach classes in a selection from Engineering Drawing and Science, Applied Mechanics, Applied Heats, Workshop Technology.

(e) ASSISTANT GRADE B (MECHANICAL ENGINEERING) to teach Mathematics in National Certificate and Craft classes.

(f) ASSISTANT GRADE B (MECHANICAL ENGINEERING) to teach classes in a selection from Calculations, Workshop Science and Drawing in courses for Machine Shop Engineering, Patternmaking, Fabrication of Steelwork. Candidates should posses a Final or Full Technological Certificate (City and Guilds) in Machine Shop Engineering.

Candidates for posts (c),(d) and (e) should hold a Degree or Higher National Certificate or equivalent qualifications. All candidates should posses suitable industrial and/or teaching experience.

Salaries in accordance with the Burnham Technical Scales:-

£1065 x £25 - £1215 per annum for posts (a) and (b)
£525 x £25 - £820 per annum with appropiate additions for degree and training for posts (c),(e) and (f).
£450 x £18 - £725 per annum with appropriate additions for post (d).

Application Forms, obtainable with further particulars from the undersigned (stamped, addresses envelope) should be returned within 14 days of the publication of this advertisement.

STANLEY MOFFETT,

Director of Education.

Education Office,
P.O.Box 67,
Leopold Street,
Sheffield, 1.

THE BRITISH SOCIETY FOR RESEARCH IN AGRICULTURAL ENGINEERING has a vacancy for a Scientific Officer (Physicist or Engineer) to carry out fundamental and applied research on grain and seeds, including investigation into their thermal and hygroscopic properties. 1st or 2nd class Hons. degree essential. Salary: £488.10.0. - £885: starting pay according to age and post-graduate experience. F.S.S.U.

Application forms from SECRETARY, B.I.A.E., WREST PARK, SILSOE, BEDS.

K835

K.699.

OXFORD UNIVERSITY

Applications are invited for the post of DEPARTMENTAL DEMONSTRATOR IN ENGINEERING SCIENCE, the duties to include both lecturing and undergraduate instruction in the laboratories. Original research will be encouraged. Salary £600 to £700 per annum (plus children's allowance and F.S.S.U.), according to qualifications and experience. Additional emoluments from tutoring may amount to £200 per annum. Applicants should have a good degree in engineering; post-graduate experience is desirable.

Apply to PROFESSOR A. THOM, DEPARTMENT OF ENGINEERING SCIENCE, 19 PARKS ROAD, OXFORD.

K.803.

FEDERATION OF MALAYA
CIVIL ENGINEERS
FOR DAM CONSTRUCTION

Duties;to take charge of site work in construction of mass concrete dam at Klang Gates using contract labour and under the general direction of P.W.D. Officers.

Appointment on Contract/Gratuity terms. Salary £2002 p.a. Other allowances:-£392 if single; £742 if married and £987 if married with child(ren). Gratuity, payable on satisfactory completion of contract at rate of £70 for each completed period of 3 months service. Free passages: Free medical attention: Generous home leave.

Candidates should be A.M.I.C.E. and have wide practical experience of heavy concrete construction including mass concrete dams.

For further particulars apply in writing to DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, LONDON, S.W.I., Give brief details of age, qualifications and experience. Quote reference BCD/112/23/03/D5. K.798.

GOVERNMENT OF BAHRAIN

STATE ENGINEER'S DEPARTMENT

POWER STATION SUPERINTENDENT required to take charge of a new Gas-engine and Gas-turbine power station with associated auxiliary equipment. Applicants should have held similar positions or equivalent responsibilities for at least three years.

The power station plant consists of 4 - 1,000kW Gas engines and 4,500kW of Diesel engines and is about to be extended by the addition of gas turbine plant. Preference will be given to candidates between 35/45 years of age holding at least H.N C., and having had operating experience on large diesel alternator plant.

Consolidated commencing salary up to £2,000 per annum according to qualifications and experience. There is also a Pension Fund.

Free furnished bachelor quarters and medical attention provided. Married accommodation provided after satisfactory completion of 6 months probationary period. Contract in the first place for a period of 2 years subject to 6 months probation. Leave is granted every two years at the rate of ten weeks per annum. Free passages by air to and from the United Kingdon are provided for the applicant and his wife every two years.

Applicants giving full details of qualifications, training and experience to be addressed to the PERSONNEL OFFICER, EWBANK & PARTNERS LTD., 10/11 GROSVENOR PLACE, LONDON S.W.1.

K.779.

WORK WANTED.

"DRAWINGS WITH TENDER?" Why not. Isometric Lay Out giving comprehensive illustration of exact proposals.—Apply BOX K 429, Offices of ENGINEERING.

B.C.S.

ONE—400 K.W. SULZER DIESEL GENERATING SET, 220/440 volts, D.C. complete with Auxiliaries, Spares, etc.
ONE—850 K.W. SULZER DIESEL ALTERNATOR SET, 400/440 volts, 3 phase, 50 cycles

STAINLESS STEEL available, ex-stock. Sheets, Bars, Tubes and Angles. Send for our priced Stock List.
THE MULBERRY COMPANY,
223, St. John Street, London, E.C.1.
Telephone: CLErkenwell 8356-7-8. G 455

NORTHERN RHODESIA

CIVIL ENGINEERS

PUBLIC WORKS DEPARTMENT

Duties: Carry out the duties of Sanitary Engineer which includes the design and supervision of construction, either by contract or direct labour of sewerage and drainage works for housing schemes including African housing; preparation of schemes for surface water drainage of building sites, and design of plumbing systems for institutional and domestic buildings of a Government or Municipal nature

Appointment on Contract/Gratuity terms. Salary from £1,290 to £1,560 p.a plus varying allowance of between £284 - £331. A gratuity at the rated of £37 : 10 : 0d. for each completed 3 months service payable on satisfactory completion of contract. Free Passages. Free Medical attention: Generous leave: Housing at reasonable rental available for a married man.

Candidates, who should be between 35-44 years of age must hold a University Degree of Diploma recognised as exempting from or have passed the Finals Parts 1 and 11 of the A.M.I.C.E.examination and must have at least 10 years experience in design and supervision of Sanitary Engineering works, including sewerage disposal, stormwater, drainage schemes and internal domestic plumbing.

Further particulars on written application to Director of Recruitment, Colonial Office, London S.W.1. Please give brief details of age, qualifications and experience and quote reference BCD/112/3/013/L5

K.642

AUSTRALIA

UNIVERSITY OF SYDNEY

Applications are invited for the position of LECTURER IN MECHANICAL ENGINEERING. Preference will be given to applicants with experience in Theory of Machines and/or Strength of Materials.

The salary will be in the range of £AI,200 - £AI,750 per annum, plus cost of living adjustment (£A3I men), and with annual increments of £A80. The salary will be subject to deductions under the State Superannuation Act. The commencing salary will be fixed according to the qualifications and experience of the successful applicant.

Finance available for home purchase under Staff Members' Housing Scheme.

Further particulars and information as to method of application may be obtained from the SECRETARY, ASSOCIATION OF UNIVERSITIES OF THE BRITISH COMMONWEALTH, 36 GORDON SQUARE,LONDON,W.C.I.

The closing date for the receipt of applications, in Australia and London, is I5 th May, 1956. K.790.

MERSEY DOCKS AND HARBOUR BOARD

Applications are invited for the position of a SURVEYOR, about 30/35 years of age, with experience in general land surveys, setting-out work and quantity surveying. Applicants should also be capable draughtsmen.

Full details of education, qualifications and experience should be furnished, together with copies of recent testimonials and/or names of referees. Applicants must have passed the Intermediate Examination of the Royal Institution of Chartered Surveyors.

The Salary will be in accordance with the Board's scale, which has recently been revised, but age, experience, etc., will be taken into account in fixing the commencing salary.

Applications should be addressed to the ENGINEER-IN-CHIEF, MERSEY DOCKS AND HARBOUR BOARD, DOCK OFFICE, LIVERPOOL,3., and received not later than the 27th April, 1956

K.646.

UNIVERSITY COLLEGE LONDON

GOWER STREET, W.C 1.

LEVERHULME STUDENTSHIPS (£400 p.a.) and SHELL STUDENTSHIPS (not less than £350 p.a.) in CHEMICAL ENGINEERING, tenable for one session (renewable for second session), are awarded to graduates in Chemistry or Engineering for advanced training or research in Chemical Engineering in the Ramsay Memorial Laboratory. Applicants for Leverhulme awards should have industrial experience. Applications, giving particulars of academic qualifications and industrial experience, with names of two referees, must be received by Registrar by 16 May,1956.

K.758

MECHANICAL ENGINEERING RESEARCH LABORATORY (D.S.I.R.), East Kilbride, Glasgow, require DESIGNER (EXPERIMENTAL OFFICER OR ASSISTANT EXPERIMENTAL OFFICER) for materials research equipment ranging from instruments to testing machines. Workshop training and experience of designing precision apparatus and machine components. Minimum qualifications: Scottish Leaving Certificate in three subjects, including Maths. and Science, in Higher Grade and two in Lower; if over 22, degree, H.N.C. or equivalent in Mech. Eng. generally expected. Inclusive salary for a 45½ hour week:- E.O.(men) £767 - £947 p.a. A.E.O. (men) £315 - £690 p.a. Slightly less for women but subject to improvement under Equal Pay Scheme.

East Kilbride has good housing prospects. Application forms from M.L.N.S., TECHNICAL AND SCIENTIFIC REGISTER (K), 26 KING STREET, LONDON, S.W.1, quoting C 195/6A. K.602

UNIVERSITY OF LONDON KING'S COLLEGE will require on October 1st.1956, a LECTURER IN ELECTRICAL ENGINEERING with special reference to Electronics. Applicants should have a good honours degree in Electrical Engineering or Physics. Salary on the scale £700 x 50- £1,000: £1,050 x 50 - £1,400 with Family Allowances and Superannuation benefits, with starting point according to qualifications and experience. Applicants should write for conditions of appointment and application forms to the REGISTRAR, KING'S COLLEGE, STRAND, W.C.2. whom completed applications must reach by April 18. K.816.

UNIVERSITY OF CAMBRIDGE:
A.E.I. FELLOWSHIPS

Applications are invited for two Associated Electrical Industries Fellowships tenable from 1 October 1956, one in the Department of Physics and one in the Department of Engineering. Stipend within the range £900-£1400 a year with family allowances and F.S.S.U. benefits. Particulars may be obtained from THE SECRETARY GENERAL OF THE FACULTIES, THE OLD SCHOOLS, CAMBRIDGE, by whom all applications must be received not later than 31 May 1956. K.765

UNIVERSITY OF LONDON KING'S COLLEGE will require on October 1st, 1956 a LECTURER IN CHEMICAL ENGINEERING. Applicants should have a good honours degree. Salary on the scale £700 x £50 - £1,000: £1,050 x 50 - £1400 with Family Allowances and Superannuation benefits, with starting point according to qualifications and experience. Applicants should write for conditions of appointment and application forms to the REGISTRAR, KING'S COLLEGE, STRAND, W.C.2. whom completed applications must reach by April 18th. K.815.

UNIVERSITY OF HONG KONG

Applications are invited for the newly-established post of REALER IN MECHANICAL ENGINEERING in the Department of Civil Engineering.

Salary (superannuable): £2,500 a year, together with an expatriation allowance of £300 a year if applicable. The equivalent of income tax in the Colony is comparatively low.

Applicants must be graduates of British Universities and Corporate Members of the Institution of Mechanical Engineer, with teaching experience at University level.

First class sea passages are provided for expatriate staff and their families on first appointment and leave.

Further particulars and information as to the method of application may be obtained from the SECRETARY, ASSOCIATION OF UNIVERSITIES OF THE BRITISH COMMONWEALTH, 36 GORDON SQUARE, LONDON, W.C.I.

The closing date for the receipt of applications, in Hong Kong and London, is 7th May, 1956. K.786.

LONDON: [illegible], LTD., by Appointment to Her Majesty The Queen, Printers, London, Hayes (Middx.), and High Wycombe, and Published by ENGINEERING Ltd., Proprietors of ENGINEERING, at 35 & 36, Bedford St., Strand, London, W.C.2.

CENTRAL ELECTRICITY AUTHORITY HQ.

Required in the Drawing Office of the Chief Engineer's Dept., Bankside House, Sumner Street, S.E.1.

DRAUGHTSMEN & SENIORS

Salaries £536 to £662
& £672 to £777

DRAUGHTSMEN

for work on graphs, charts and general statistical work.

Salaries £455 to £555
& £555 to £615

TRACERS

Salaries £205 at age 16 rising eventually to £525.

Canteen. One Saturday morning in four on duty. Permanent Pensionable appointments.

Applications stating age, qualifications, present position and salary to D. MOFFAT, DIRECTOR OF ESTABLISHMENTS, WINSLEY STREET, LONDON, W.1. Quote ref. ENG/765.

K.763

UNIVERSITY OF DURHAM

Applications are invited for a PROFESSOR OF MARINE ENGINEERING. The Chair is a newly created one and is tenable in the Newcastle Division of the University. The salary will be within the Professional range, together with family allowances and membership of the F.S.S.U. Further particulars may be obtained from the undersigned with whom eighteen copies of application should be lodged not later than Monday, 30th April, 1956. Candidates outside the British Isles may submit one copy only.

E.M.BETTENSON
Registrar
University Office,
46 North Bailey
Durham K.792.

LONDON COUNTY COUNCIL

POPLAR TECHNICAL COLLEGE, as soon as possible. Mechanical Engineering and Naval Architecture Department: (1) TWO LECTURERS. Should possess degree or professional qualification with both teaching and industrial experience. For one of these posts, special qualifications in workshop technology and workshop practice are desired. (2) ASSISTANT GRADE B TO TEACH C & G and/or Nat.Cert. classes. Industrial and/or teaching experience is neccessary. Burnham F.E.salary scales (1)£965 x £25 - £1,065; (2) £525 x £25 - £934, commencing and maximum salary according to age, qualifications and experience, all posts plus London allowance of either £36 or £48. Application forms from SECRETARY AT COLLEGE, POPLAR HIGH STREET, E.14, to be returned by 14th April 1956.(431)

K.702.

MECHANICAL ENGINEERS

(INSPECTORS OF MACHINERY)

FEDERATION OF MALAYA (BCD.99/60/02)

Required to survey boilers, pressure vessels, prime movers etc., conduct examinations of engineers and engine-drivers, investigate machinery accidents and enforce safety precautions.

Appointment pensionable, salary range £1,145 - £2,120 including pensionable expatriation allowance, point of entry depending on experience and war service. Non-pensionable expatriation allowance for married candidates from £91-£295 per annum. Substantial cost of living allowance.

Free passages for officer, wife and 3 children under age of 10. Furnished quarters, if available, at reasonable rents. Four days leave for each month of residential service.

Candidates aged 26-35, must have passed or be exempt from Parts A and B of the examination for A.M.I.Mech.E. Should have served an apprenticeship in Mechanical Engineering including 3 years workshop experience on steam and oil engine manufacture or repair, and have had 2 years in a position of responsibility. Executive experience of boiler operation, maintenance and/or inspection an advantage.

Apply in writing to the DIRECTOR OF RECRUITMENT, (COLONIAL OFFICE), LONDON S.W.1. stating briefly age, qualifications and experience, and quoting reference number BCD/60/02

K.820.

UNIVERSITY OF HONG KONG

Applications are invited for the vacant CHAIR OF CIVIL ENGINEERING.

Salary (superannuable): £3,250 a year, together with an expatriation allowance of £350 a year if applicable. The equivalent of income tax in the Colony is comparatively low.

Applicants must be graduates of a British University and Corporate Members of the Institution of Civil Engineers.

First class sea passages are provided for expatriate staff and their families on first appointment and leaves. A furnished flat or house is provided at a reasonable rental.

Further particulars and information as to the method of application may be obtained from the Secretary, ASSOCIATION OF UNIVERSITIES OF THE BRITISH COMMONWEALTH, 36 GORDON SQUARE, LONDON, W.C.1.

The closing date for the receipt of applications, in Hong Kong and London, is 7TH MAY, 1956

K789

MINISTRY OF SUPPLY
require
PRINCIPAL SCIENTIFIC OFFICER (min. age 31) at R.A.E., Farnborough, to lead section engaged in research and development of automatic flight controls. Candidates should have 1st or 2nd class Hons. degree in Physics or Electrical Engineering with considerable experience of servo systems and other electrical mechanical devices. Some knowledge of aircraft dynamics and aircraft instruments an advantage. At least three years post graduate research experience required. Salary within range: P.S.O. £1,185 - £1,567 (Superannuable). Application forms from M.L.N.S., TECHNICAL AND SCIENTIFIC REGISTER (K), 26 KING STREET, LONDON, S.W.1. quoting A 76/6A/B9. K.600

BARROW-IN-FURNESS
EDUCATION COMMITTEE
CENTRAL COLLEGE
OF
FURTHER EDUCATION

Required in September 1956, a FULL-TIME ASSISTANT, GRADE A, to teach MECHANICAL ENGINEERING and allied subjects to Ordinary National Certificate level; ability to offer Mathematics and Strength of Materials to A.1 level will be an advantage. Applicants should have had good industrial experience and should possess sound technological and/or graduate qualifications. Burnham Scale, viz; £450 by £18 to £725 with additions in respect of approved qualifications and training and for suitable industrial and teaching experience. Application forms, obtainable by sending a stamped, addressed foolscap envelope to the CHIEF EDUCATION OFFICER, JOHN WHINNERAH INSTITUTE, BARROW-IN-FURNESS, should be returned as soon as possible.

Town Hall,
Barrow-in-Furness. LAWRENCE ALLEN
Town Clerk.

K.653.

WORK WANTED.

"DRAWINGS WITH TENDER?" Why not. Isometric Lay Out giving comprehensive illustration of exact proposals.—Apply BOX K 429, Offices of ENGINEERING.

B.C.S.

ONE—600 K.W. SULZER DIESEL GENERATING SET, 220/440 volts, D.C. complete with Auxiliaries, Spares, etc.
ONE—850 K.W. SULZER DIESEL ALTER-

STAINLESS STEEL available, ex-stock. Sheets, Bars, Tubes and Angles. Send for our priced Stock List.
THE MULBERRY COMPANY,
223, St. John Street, London, E.C.1.
Telephone: CLErkenwell 8356-7-8. G 455

CIVIL ENGINEERS

Vacancies exist with the UNITED KINGDOM ATOMIC ENERGY AUTHORITY, INDUSTRIAL GROUP, at sites in the North of England and Scotland.

DUTIES:

Supervision of site work on the construction of Atomic Energy plants.

QUALIFICATIONS AND EXPERIENCE:

Applicants should be Corporate Members of the Institution of Civil Engineers and have wide experience of the Civil Engineering aspects of large sites. Possession of a University Degree, coupled with some design experience, is desirable.

SALARY:

Grade I	£1,490	rising by annual increments of approx. £45 to £1,685 p.a.
Grade II	£1,130	rising by annual increments of approx. £40 to £1,435 p.a.
Grade III	£728	rising by annual increments of approx. £30 to £1,130 p.a.

Successful candidates if under 55 will be required to join the Authority's contributory pension scheme.

Suitably qualified persons are invited to send a POSTCARD for form of application (quoting reference 1339) to RECRUITMENT OFFICER, U.K.A.E.A., INDUSTRIAL GROUP, H.Q., RISLEY, NEAR WARRINGTON.

K 827

NORTH STAFFORDSHIRE TECHNICAL COLLEGE, STOKE-ON-TRENT.

Principal: H. W. Webb, O.B.E., D.Sc.

Applications are invited for the post of full-time ASSISTANT LECTURER (GRADE B) IN MECHANICAL ENGINEERING.

Applicants should preferably possess a degree or equivalent qualification and be capable of teaching to Higher National Certificate standard. Ability to teach one or more of the subjects Strength of Materials, Mechanics of Machines, Mechanics of Fluids, or Applied Thermodynamics, to degree standard would be an additional recommendation.

Salary according to the Burnham Technical Scale for Assistants Grade B (£525 x £25 to £820), with full additions for training, graduate qualification and experience.

Applications giving details of qualifications, training and experience, together with the names of two referees, should be sent to the Principal as soon as possible.

H. DIBDEN,
Clerk to the Governors.
K.761

SITE ENGINEERS REQUIRED for contracts at Northern Outfall Works, Beckton, E.6

DEPUTY AND ASSISTANT RESIDENT ENGINEERS. (senior) up to £1,250 and £1,050 p.a. respectively according to experience. Should be qualified engineers with experience of construction of heavy engineering works, pile-driving, reinforced concrete and capable of directing site staff.

MEASUREMENT ENGINEERS up to £1,050 p.a. Must be thoroughly experienced in measurement of works, preparation of accounts, price variations, etc. and able to accept full responsibility for such matters. Would suit older engineers.

ASSISTANT RESIDENT ENGINEERS up to £840 p.a. Must be able to set out works and have previous site experience.

CIVIL ENGINEERING ASSISTANTS up to £675 p.a.

Application form from CHIEF ENGINEER (56/19), COUNTY HALL, LONDON, S.E.1.
(334) K648

GOVERNMENT OF NORTHERN NIGERIA

MECHANICAL ENGINEER (ROADS)

TEMPORARY

PUBLIC WORKS DEPARTMENT

To supervise and control maintenance and repairs to all types of equipment including road making plant, heavy earth moving plant, general contractors plant, waterworks installations and vehicles. Contract appointment in salary range £1,290 - £1,956. Gratuity £37.10s for each completed 3 months service payable on satisfactory completion of contract. Quarters, if available, at a rental of 8½/3% of salary; maximum £150 p.a. Free passages for Officer and wife. Assistance with passages for children and allowances may be paid up to a maximum of three children under 18. Seven days leave for each month of resident service in a tour of 18-24 months.

Candidates over 25 should hold a University Degree in Mechanical Engineering or should have passed or be exempt from Sections A and B of the examinations for A.M.I.Mech E. or A.M.I.C.E.(in Mechanical subjects) and have at least three years practical experience of mechanical engineering work, experience of diesel and petrol engines, drawing office and machine shop practice, workshops and stores procedure.

Apply in writing to the Director of Recruitment, Colonial Office, Great Smith Street, London S.W.1, giving briefly age, qualifications and experience. Mention the reference number BCD 112/408/015. K.641

HAURAKI CATCHMENT BOARD

Applications, closing 4th May 1956, are invited for a QUALIFIED ASSISTANT ENGINEER on the Board's Staff. Address applications to "Hauraki Catchment Board, P.O. Box 7, Te Aroha, New Zealand." Commencing Salary £1000 - £1200 p.a. according to qualifications and experience. Conditions of Appointment etc. obtainable from the proprietors of this journal.

C.H. WALSH,
SECRETARY
K662

SUNDERLAND EDUCATION COMMITTEE

THE TECHNICAL COLLEGE

PRINCIPAL: D.A.WRANGHAM M.SC (LOND), SEN.WH.SCH.,A.C.G.I.,D.I.C.,M.I.MECH.E.

Applications are invited for the post of SENIOR LECTURER IN MECHANICAL ENGINEERING.

Candidates must have a good Degree in Engineering, together with industrial experience and teaching experience at Degree Level. Ability to offer Heat Transfer and Mechanics of Fluids would be a strong recommendation.

Salary in accordance with the Burnham Technical Scale:-

£1065 by £25 to £1215 per annum

Further particulars may be obtained from the Registrar, The Technical College, Sunderland, Co.Durham.

Applications must reach the undersigned as soon as possible after the appearance of this advertisement.

Canvassing will be a disqualification.

W.THOMPSON
Director of Education
EDUCATION OFFICES
JOHN STREET,
SUNDERLAND
K.822.

ADEN

PUBLIC WORKS DEPARTMENT

SENIOR EXECUTIVE ENGINEER

DUTIES: To take charge of Engineering Branches of the P.W.D.(Roads, Water and Drainage).

Appointment on Contract/Gratuity terms for 18-24 months in first instance. Gross emoluments, according to age and experience, in incremental range £1548 - £1788 p.a. plus a gratuity at the rate of £150 p.a. on satisfactory completion of contract. £60 Outfit allowance: Quarters available at reasonable rental. Free Medical attention: Generous home leave: Low Income Tax.

Candidates should hold a degree or diploma in Civil Engineering recognised as exempting from, or having passed the Final Parts I and II of the A.M.I.C.E. exam. plus considerable practicable experience of Civil Engineering especially in Waterworks.

Apply in writing to DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, LONDON S.W.1. Give brief details of age, qualifications and experience. Quote reference BCD 112/2/08/D5. K.639.

ENGINEERING DRAUGHTSMAN required. State age, training, experience and salary required, to MINISTRY OF WORKS (ESTAB.), BROOKLANDS AVENUE, CAMBRIDGE. K.605

LONDON: H... LTD., by Appointment to Her Majesty The Queen, Printers, London, Hayes (Middx.), and High Wycombe, and Published by ENGINEERING Ltd., Proprietors of ENGINEERING, at 35 & 36, Bedford St., Strand, London, W.C.2.

OXFORDSHIRE EDUCATION COMMITTEE

WEST OXFORDSHIRE TECHNICAL COLLEGE

WITNEY

PRINCIPAL: E.A.CHILCOTT,B.Sc.(ECON).

Required for 1st May, or as soon as possible thereafter, Grade A Assistant Lecturer in the Department of Engineering and Building. Applicants should have served an apprenticeship in the Machine Shop, Toolroom or General Engineering Shop. Minimum qualifications required: Ordinary National Certificate or Final City & Guilds Machine Shop Engineering Certificate. The successful applicant will be expected to teach Machine Shop Engineering subjects to Intermediate level, Engineering Drawing and /or Practical Mathematics to S.1 standard and Workshop Practice and Theory in the Secondary Technical Department. Ability to assist with Elementary Auto Work and/or Welding would be an additional qualification. Application forms obtainable from the undersigned should be returned to the Principal within fourteen days of the appearance of this advertisement.

A.R.CHORLTON,
Director of Education
County Offices,
Oxford. K.812

ELECTRICAL OR MECHANICAL ENGINEER (minimum age 21) required by MINISTRY OF SUPPLY, Research and Development Establishment near Sevenoaks, Kent, to assist in basic development of mechanical and electro-mechanical devices for projectiles and rockets. Candidates should possess 1st or 2nd class honours degree or equivalent qualification in Electrical or Mechanical Engineering. Some appropriate post graduate experience is desirable. Salary within Scientific Officer range. £488 10s. - £885 (Superannuable). Application forms from M.L.N.S., TECHNICAL AND SCIENTIFIC REGISTER (K), 26 KING STREET, LONDON, S.W.1. quoting D 82/6A/B9. K.607

FIJI - PUBLIC WORKS DEPARTMENT

ASSISTANT ENGINEERS (CIVIL)

Appointment on probation for permanent and pensionable establishment. Salary in incremental scale £1081 - £1441 p.a. Free Passages; Free medical attention for Officer: Generous home leave: Low Income Tax.

Candidates should hold a University degree or diploma recognised as exempting from or have passed the Final Parts 1 and 11 of the A.M.I.C.E examination and have considerable practicable experience in maintenance and construction of roads, bridges, and general engineering works.

Apply in writing to DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, LONDON S.W.1. Give brief details of age, qualification and experience. Quote reference BCD/112/49/04/D5. K.637.

CIVIL ENGINEERS

KENYA

Vacancies exist in various branches of the Public Works and Agricultural Departments in Kenya for Engineers to be employed on Civil Engineering works including Irrigation Projects, Hydrology, and Road Development.

Appointment on Contract/Gratuity terms with gross emoluments in incremental range £1,135 - £1,782 p.a. plus substantial gratuity on satisfactory completion of contract: Free passages: Free medical attention: Generous Leave.

Candidates must either (a) possess an Engineering Degree or Diploma recognised as granting expemtion from Final Parts 1 and 11 of the examinations of the Institution of Civil Engineers and at least two years professional experience; or (b) have passed Final Parts 1 and 11 of the Institutions examinations or an exempting diploma and have had at least five years "approved professional experience". Experience in excess of the minimum will be considered in determining starting salary.

Further particulars on written application to DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, LONDON S.W.1. Give brief details of age, qualifications and experience. Quote reference BCD112/7/018/D5. K.638

ENGINEERS (Aeronautical, Mechanical, Electrical) required at various MINISTRY OF SUPPLY Experimental Establishments for research and development work on guided missiles, rockets, gas turbines, aircraft and aircraft equipment. Qualifications: Higher School Certificate (Science) or equivalent but a pass degree, H.N.C. or equivalent may be an advantage. Some experience in above duties desirable. Salary according to age, experience etc., within ranges:- Assistant Experimental Officer £306 10s. (age 18) to £670: Experimental Officer (age 26) £745 - £920. Application forms from M.L.N.S., TECHNICAL AND SCIENTIFIC REGISTER (K), 26 KING STREET, LONDON, S.W.1., quoting C.181/6A/B9. K.608

MINISTRY OF SUPPLY, NATIONAL GAS TURBINE ESTABLISHMENT, near Farnborough, Hants., requires MECHANICAL ENGINEERS, AERODYNAMISTS, PHYSICISTS, CHEMISTS and MATHEMATICIANS for gas turbine research in Experimental Officer class. Qualifications: Higher School Certificate (Science) or equivalent, but degree or H.N.C. in an appropriate subject may be an advantage. Limited number of houses available from time to time for married candidates. Salary within range, E.O. (min. age 26) £745 - £920: Assistant E.O. £306 10s. (age 18) - £670. Application forms from M.L.N.S. TECHNICAL AND SCIENTIFIC REGISTER (K), 26 KING STREET, LONDON, S.W.1. quoting C 183/6A/B9. K.609

MECHANICAL ENGINEER (minimum age 26) required at MINISTRY OF SUPPLY Research and Development Establishment, near Horsham, Sussex to join team engaged in development of propulsive equipment and stores. Qualifications: Higher School Certificate (Science) or equivalent, but pass degree or H.N.C. in Mechanical Engineering may be an advantage. Detailed experience of work not necessary, but keeness for experimental engineering work required. Salary within Experimental Officer range £745 - £920. Application forms from M.L.N.S., TECHNICAL AND SCIENTIFIC REGISTER (K), 26 KING STREET, LONDON, S.W.1., quoting C 175/6A/B9. K.606

UNIVERSITY OF CAMBRIDGE

DEPARTMENT OF CHEMICAL ENGINEERING

Applications are invited for the post of University Demonstrator in Chemical Engineering from persons of broad scientific education experienced in some branch of chemical engineering, mechanical engineering or physics. Further particulars and forms of application may be obtained from the Secretary of the Appointments Committee, DEPARTMENT OF CHEMICAL ENGINEERING, TENNIS COURT ROAD, CAMBRIDGE, by whom applications should be received by 17.April, 1956. K.753.

APPOINTMENTS OPEN.

PETER BROTHERHOOD LTD.

are desirous of appointing an EXPERIENCED MAN AS WORKS ENGINEER who would be responsible to the Board.

The firm are general Engineers manufacturing a large variety of high class products, and candidates for this appointment should hold a University degree in Engineering and should have had several years' experience in mechanical engineering.

The position offers to the right man prospects of advancement to the highest levels.

None but first-class men need apply as the salary offered will be a liberal one.

Applications giving age, qualifications and details of experience should be addressed to the SECRETARY, PETER BROTHERHOOD LTD., PETERBOROUGH. K.486

DESIGNER-DRAUGHTSMAN required for interesting new developments. Ability to do own stressing essential and railway carriage and wagon experience an advantage. Permanent position with excellent prospects. Apply in writing giving full details which will be treated in strict confidence to:

METALASTIK LTD., LEICESTER.

K 828

WORK WANTED.

"DRAWINGS WITH TENDER?" Why not. Isometric Lay Out giving comprehensive illustration of exact proposals.—Apply BOX K 429, Offices of ENGINEERING.

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ONE—850 K.W. SULZER DIESEL ALTER-

STAINLESS STEEL available, ex-stock. Sheets, Bars, Tubes and Angles. Send for our priced Stock List.
THE MULBERRY COMPANY, 223, St. John Street, London, E.C.1. Telephone: CLErkenwell 8356-7-8. G 456

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F. J. 3
Tel
LANSDOWN

DRAUGHTSMEN/ DESIGNERS. Required by London Office of SHELL PETROLEUM CO. LTD. Fully experienced in one of the following categories;-
(1) Structural steelwork, with some experience of R.C. structures and foundation work preferred.
(2) Mechanical or general engineering. Preferably between the ages of 30 and 40. Salary according to age and experience. Pension Scheme. Canteen facilities. Social and sports club facilities. Please apply in writing, giving full details, to STAFF DEPARTMENT (R)., ST. HELEN'S COURT, 9T. ST. HELEN'S, LONDON, E.C.3. K.538

BRITISH OXYGEN GASES LIMITED require the services of a SENIOR MECHANICAL DRAUGHTSMAN for work in the West End of London. Applicants should have a good general engineering background with some particular experience in pipework. Experience in General Factory maintenance, heating and ventilation an advantage. Reply, stating full details of age, qualifications and experience to PERSONNEL MANAGER, BRITISH OXYGEN GASES LIMITED, BRIDGEWATER HOUSE, CLEVELAND ROW, ST. JAMES'S, LONDON, S.W.1. K782

A well-known Organisation wishes to interview YOUNG MEN WHO WOULD EVENTUALLY BE CAPABLE OF FILLING SENIOR MANAGEMENT POSITION within its Sales Organisation. It is essential that candidates should already have had considerable experience of selling engineering materials in the field and have progressed into a junior or middle managerial position. This opportunity offers very good prospects and an attractive commencing salary. Age range 30/35. Write, stating full details of age, experience, together with an indication of present earnings to BOX K783 Offices of Engineering.

WORKS MANAGER to take complete charge of modern factory fabricating tanks for food, chemical and brewing industries, in stainless steel, mild steel and aluminium; good knowledge of all welding techniques including Argonarc. Approximately 100 employees. Applications stating age, education qualifications and experience to Box K 833 Offices of ENGINEERING.

MECHANICAL ENGINEER required to be responsible to the Chief Engineer for the Plant and Building Maintenance Departments of a large Tube Works in Birmingham. Applicants, who should be between the ages of 27 and 34, should possess an Engineering Degree or equivalent qualification in Mechanical Engineering and have had considerable experience in medium/heavy engineering with at least 2 years in a supervisory position. This is an excellent opportunity, for the right man, in a Company which is part of a large expanding Group. Pension Scheme in operation. Please send details of qualifications and experience together with salary required to PERSONNEL MANAGER, TUBES LIMITED, ROCKY LANE, ASTON, BIRMINGHAM.6. K.826.

Major Industrial Organisation has vacancies for SCIENTIFIC AND ENGINEERING STAFF in its expanding Research and Development Laboratories in the Midlands for work on automatic plant applied to nuclear processing equipment. Candidates should have an honours degree in science or engineering or alternatively a good engineering training combined with graduate membership of a recognised institution. Experience in one or more of the following subjects will be advantageous but it is not essential:-

Automatic control systems
Design of precision mechanisms.
Industrial application of electronic instruments
Computing devices applied to control systems.
Design of machine tools.
Design of mechanical handling equipment

Candidates should be 27-38 years of age and starting salary will be in the range £800 to £1500 according to age and experience

Vacancies also exist for junior engineers, age 23-27, starting salary £600-£800, according to age and qualifications. Candidates would be expectel to have H.N.C. or to be engaged on a recognised course of study for H.N.C. or graduate membership of a recognised institution.

Successful candidates will be expected to join the organisations superannuation scheme. Reasonable removal expenses will be paid. Apply to Personnel Manager, Box K.825, Offices of Engineering.

CEMENT & CONCRETE ASSOCIATION

CIVIL ENGINEERS

FOR RESEARCH

Engineers required for research on the properties of concrete and on the design and behaviour of structures at the Association's Research Station, Stoke Poges, Bucks. Applicants should be under 27 years of age and have a degree (Preferably honours) in engineering. Experience is not essential but up to one year's work on construction sites would be an asset. The posts are pensionable and give good opportunities for obtaining higher degrees and specialized knowledge. Final year students who have done national service would be considered.

CEMENT & CONCRETE ASSOCIATION
52 GROSVENOR GARDENS
LONDON S.W.1.
K.498

MERZ AND MCLELLAN

have vacancies in their Esher Office for MECHANICAL ENGINEERING DRAUGHTSMEN. Applicants should be experienced in plant layout work preferably, but not essentially, in connection with steam power stations. Salaries will be fully appropriate to applicants' experience starting at about £680 per annum at 25 years. Excellent working conditions. Five-day week. Pension Scheme. Canteen. Apply in writing to MERZ AND MCLELLAN MILBURN, ESHER, SURREY. K.481

Immediate openings are available for DRAUGHTSMEN (Ord. National Cert. minimum standard) and RESEARCH ENGINEERS (Higher Nat. Cert. minimum) in our various departments at Elswick and Scotswood Works. Interested applicants should write to: Personnel Officer, VICKERS-ARMSTRONGS (ENGINEERS) LIMITED, ELSWICK WORKS, NEWCASTLE UPON TYNE. K746

PHYSICISTS AND ENGINEERS.

IMPERIAL CHEMICAL INDUSTRIES LIMITED, General Chemicals Division, has vacancies for GRADUATE PHYSICISTS AND ELECTRICAL ENGINEERS for work on a variety of interesting problems demanding a wide appreciation of physical principles. The work will be concerned with the development of continuous analysis instruments and automatic control schemes for large modern chemical plants. Facilities are available for development work both in the laboratory and on the plant, and for the implementation of the results obtained in collaboration with the Engineering Design Department. It is intended to make these appointments towards the end of the year and they may therefore be of particular interest to Graduates who are at present nearing the completion of their National Service. Excellent prospects exist for men of the right type and the successful candidates will be appointed to the permanent staff of the Company with membership of the Pension Fund. There is also a Profit Sharing Scheme. Where necessary, assistance can be given to married men in connection with house purchase and removal expenses. Apply, giving full particulars, to STAFF MANAGER, IMPERIAL CHEMICAL INDUSTRIES LIMITED, GENERAL CHEMICALS DIVISION, CUNARD BUILDING, LIVERPOOL, 3. K.764

ASSISTANT PUMP TESTER required by HAYWARD TYLER & CO. LTD., LUTON, BEDS. Applicants should preferably have served a general engineering apprenticeship, possess O.N.C.(Mech.) and have previous experience of the manufacture or operation of centrifugal pumps. However, proof of ability to learn fast, initiative and a broad engineering experience in a position of responsibility such as that of an Engineer Officer at sea will merit consideration of any application, as training will be given. Applications in writing giving details of age, experience, qualifications and present salary should be addressed to the Personnel Manager. K.772

LONDON: H... LTD., by Appointment to Her Majesty The Queen, Printers, London, Hayes (Middx.), and High Wycombe, and Published by ENGINEERING Ltd., Proprietors of ENGINEERING, at 35 & 36, Bedford St., Strand, London, W.C.2.

Large open cast iron ore mining Company in Malaya require the services of a competent open pit Mining Engineer for the supervision of maintenance and operation of 4½ yd. shovels, tourmarockers, Euclids, Caterpillar tractors, etc. Free accommodation, first class passages, salary in accordance with qualifications. Write giving full particulars of experience and qualifications to Box N. 9765, c/o CHARLES BARKER & SONS LTD., 31, BUDGE ROW, LONDON, E.C.4. K.613

ESSO PETROLEUM COMPANY, LIMITED, require ASSISTANT MECHANICAL ENGINEERS for resident staff on construction work in the Bristol area. Applicants should have an Engineering Degree or a Higher National Certificate in Mechanical Engineering. They should have served a recognised apprenticeship and have subsequent design and construction experience on heavy mechanical engineering work including preferably pipework, pumps, boilers and structural steelwork. Some experience of site construction would be an advantage. Applicants should apply in writing to the PERSONNEL MANAGER, 16, CHARLES II STREET, S.W.1. K.766

TECHNICAL REPRESENTATIVE

Gear division of GEORGE ANGUS & CO LTD. have a vacancy for a Technical Representative, preferably of Scottish extraction, to reside in Glasgow area. Territory will comprise the whole of Scotland with occasional visits to Ireland.

Applications are invited from fully qualified mechanical engineers with specialised knowledge of gears and gear units, and with sales experience.

Generous remuneration on salary plus commission basis. Car provided and travelling expenses paid.

This responsible post with and old-established and progressive organisation offers an exceptional opportunity to the right type of man.

Applications in writing to:

PERSONNEL MANAGER,
GEORGE ANGUS & CO LTD.,
WALKER ROAD,
NEWCASTLE-ON-TYNE 6.

K.801.

DRAUGHTSMAN AND DESIGNERS required for the following types of work in expanding company:-

(a) Gas Turbine Projects
(b) Special Purpose Machine Tools and Attachments

Men other than draughtsmen, but with suitable background, considered for training.

Please write, giving details of experience and stating vacancy for which applying, to REF. D.110, CENTRAX POWER UNITS LTD., VICTORIA ROAD, FELTHAM, MIDDLESEX. K.762

DESIGNER DRAUGHTSMAN required in London for the preparation of Schemes and estimates for comprehensive materials handling installations. Must have had design experience in bulk handling equipment for Power Stations, Steelworks, Gas Works etc., and only those having this experience will be considered. The position is a permanent one and the commencing salary will be of the order of £1,000. per annum. A contributory pension scheme is in operation. Applicants should give the fullest details in first instance, and replies should be addressed to Box K 829 Offices of ENGINEERING.

TECHNICAL LIAISON ENGINEER. British Empire Licensees for interesting new engine system require experienced graduate engineer with knowledge of diesel engines for technical liaison and interchange of information between licensees in Britain and abroad. Clear thinking and ability to get on with people important. Knowledge of French an advantage. Older men and recently retired Royal Engineer or Royal Navy engineer officers considered. Salary according to qualifications and experience. Write giving experience, qualifications, salary expected, and age.
Box K 832 Offices of ENGINEERING.

MECHANICAL ENGINEERING DRAUGHTSMEN required with training in Maintenance Building and Mechanical problems. A knowledge of machine design would be an advantage. The positions are pensionable and progressive. Applications stating qualifications, age and previous experience should be addressed to the WORKS PERSONNEL OFFICER, PILKINGTON BROTHERS LIMITED, RAVENHEAD WORKS, ST.HELENS, LANCASHIRE. K.759

CONSULTING ENGINEERS require steelwork Inspector of Works for erection Power Station South Wales. Qualifications - must be trained and experienced in erection of structural steelwork. Apply SIR BRUCE WHITE, WOLFE BARRY & PARTNERS, 1, LYGON PLACE, S.W.1 K 831

RESEARCH SCIENTISTS are required for interesting new developments in domestic heating. Candidates should have a degree or equivalent in Physics. Previous research experience is not necessary, but applicants must have an aptitude for original work and the ability to apply a scientific training to practical objectives. The work is concerned with recent developments, and offers opportunities for training and experience in modern research techniques and instrumentation in exceptionally well-equipped laboratories. The posts also offer opportunities for publishing the results of successful research and good prospects of advancement for graduates with research ability. Starting salary in range £600-£900. 5 day week. Superannuation and Grading Schemes. Apply in writing to ASSISTANT SECRETARY, REF. B.48, B.C.U.R.A., RANDALLS ROAD, LEATHERHEAD. K747

CAPABLE DESIGNER - DRAUGHTSMAN (MECHANICAL) wanted for work on Wire and Tube drawing Machines etc. Experience in this class of work preferable but not essential. Commencing salary £900 p.a. Good general conditions - pension scheme Assistance given with housing and removal expenses. Reply, giving full details of age and experience to Box K.754, Offices of Engineering.

PRESS SHOP SUPERINTENDENT

Expanding Engineering Company requires a Press Shop Superintendent for their works at Speke, Liverpool. Applicants should have a sound knowledge of all aspects of Light Steel Press Work and be able to maintain production and control male and female labour.

There is a Staff Superannuation Scheme and excellent working conditions, Applications stating full details of age, experience etc., should be addressed to Box No. Z236 LEE & NIGHTINGALE, LIVERPOOL. K.499.

MECHANICAL ENGINEERING DESIGNER with experience of hopper feeds, selecting, indexing and transfer mechanisms, and inter-operation mechanical handling equipment required for interesting work in these fields and on special-purpose machine design. Excellent scope in small d.o. of rapidly expanding, non-manufacturing design organisation in Central London. Box No. 9713 c/o CHARLES BARKER & SONS LTD., 31, BUDGE ROW, E.C.4. K.612

ESSO PETROLEUM COMPANY, LIMITED, have vacancies in London for MECHANICAL ENGINEERING DRAUGHTSMEN. Applicants should have a Higher National Certificate or National Certificate in Mechanical Engineering, Workshop training and drawing office experience, preferably on Plant layout. The positions are pensionable and luncheon vouchers are issued. Applicants should apply in writing to the PERSONNEL MANAGER, 16, CHARLES II STREET, S.W.1. K.767

WORK WANTED.

"DRAWINGS WITH TENDER?" Why not. Isometric Lay Out giving comprehensive illustration of exact proposals.—Apply BOX K 429, Offices of ENGINEERING.

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LANSDOWN

An appointment with outstanding prospects is to be made in a prominent Industrial Organisation with headquarters in London, within the next three months. The position will call for a MAN WITH A UNIVERSITY DEGREE OR EQUIVALENT, a good experience of industrial administration and shop-floor conditions, and the ability, after special training, to direct production work in Industry. Starting salary will be in accordance with experience and £3,000 per annum is attainable within 6 - 10 years. Age approximately 28 to 35 years. Please send full details of education and experience to Box K745 Offices of Engineering.

MANAGEMENT CONSULTANCY. An expanding Organisation of Management Consultants to Industry has two vacancies for potential Consultants. A University Degree, preferably but not necessarily in Engineering or Science, and good experience of factory conditions are essential. Applicants should be between 28 and 35, keen, ambitious and go-ahead. These are important appointments which can lead to promotion to the £3,000 - £4,000 salary bracket within 6 - 10 years. Earnings not less than £1,450 after Training Course. Substantial employee benefits, including Pension and Life Assurance. Please write with full details of education and experience to BOX K.692 Offices of ENGINEERING.

The following vacancies in the Staff of a large integrated Iron and Steel Works will shortly occur and applications are invited from suitably QUALIFIED METALLURGIST/CHEMISTS in the age range 28-35.

(1) TWO SHIFT METALLURGISTS - duties include quality control observations and liaison with Production Departments, mainly on the Steel Production side. These posts are suitable for younger men with a good theoretical background, who are keener on the production aspect than on laboratory work.

(2) ONE FOUNDRY METALLURGIST/chemist for a Foundry manufacturing iron ingot moulds and general iron castings, including non-ferrous castings. A keen well-qualified person is required for this post, which may involve building up in the future a comprehensive technical control in a new Foundry, which may incorporate also the manufacture of steel castings.

All posts are pensionable and salaries will be adequate and commensurate with abilities. Box K694. Offices of Engineering.

A DESIGNER-DRAUGHTSMAN aged 23-28 is required by THOMAS HEDLEY & CO. LTD., for the Plant Engineers Office of their Trafford Park works. Applicants should preferably be of Higher National Certificate standard and have had experience in factory maintenance and plant modifications including piping, pumping and conveyor layouts, also equipment design. Some experience on elementary civil and structural work would be an advantage. The type of man required is expected to be capable of promotion to Engineer status within an expanding organisation. The Company offers excellent conditions and salary with increases based on merit. Pension scheme, free life assurance etc. Apply in writing to PERSONNEL MANAGER, THOMAS HEDLEY & CO. LTD., TRAFFORD PARK, MANCHESTER, 17.
K698

ASSISTANT ENGINEER required for Maintenance Department of Chemical Plant on North East Coast, A.M.I. Mech. E. preferred. Experience of Rotary Kilns, Pumps, Elevators and conveyors desirable. Apply Box K749 Offices of Engineering.

POWER MAINTENANCE ENGINEER required. Must be experienced in the operation and maintenance of Water Tube Boilers, Electric Power and Lighting installations, and in controlling small staff. Pension Scheme.

Apply in writing, stating age, qualifications and copies of references to:
THE VICTORIA CARPET CO. LTD.,
KIDDERMINSTER
K697

CHIEF INSPECTOR

A large Engineering Company in the North West requires a Chief Inspector for the establishment of Inspection procedure covering all stages of manufacture. A man with good engineering background and experienced required. Appointment will be a permanent one and offers unlimited scope, age level 30-45. Commencing salary in accordance with experienced. Pension and Life Assurance Scheme in operation. Apply in confidence giving full details of qualifications and experienced to:- P242, LEE & NIGHTINGALE, LIVERPOOL.
K.500.

SENIOR ENGINEER required for post involving investigations into expansion and development of all factory services, excluding electrical. Applicants should have University Degree or be a Corporate Member of the Institution of Mechanical Engineers, Chemical Engineers, or Heating and Ventilating Engineers. Starting salary in keeping with remuneration to engineers at present time. There are prospects of promotion.

Applications, giving brief details of experience and career to Box.K705 Offices of Engineering.

INSTRUMENT ENGINEER required to take charge of Instrument Department of large Rayon Yarn producing factory. Duties will include the preparation of instrument specifications for new plant and influencing the application of instrumentation to existing plant.

Applicants should be corporate members of the Institution of Electrical of Mechanical Engineers or have an appropriate University degree and have had experience of Chemical Plant instrumentation. Experience with Electronic equipment would be an advantage. Age 30 - 45 years. Pension Scheme. Salary according to qualifications and experience. Applications which will be treated confidentially should state age, qualifications, experience and be addressed to PERSONNEL MANAGER, BRITISH ENKA LIMITED, AINTREE, LIVERPOOL.9.
K.700.

Old established Firm of West Midland Engineers engaged in the construction of Pressure Vessels and other Welded fabrications in Mild Steel, Stainless Steel and other metals, has a vacancy for ASSISTANT WORKS MANAGER. Applicants should be about 35 years old and have served an Indentured Apprenticeship in Engineering.

Production experience in a supervisory capacity is essential, as is also a suitable qualification such as A.M.I.M.E. or an engineering degree.

Further and fuller particulars for suitable Applicants. Box K688 Offices of Engineering.

YOUNG ENGINEER, with works experience and keen on commercial side, wanted for HEAD OFFICE SALES DEPT. Pension Scheme. Apply in confidence, stating age, qualifications and full particulars employment to date, MANAGING DIRECTOR, MEGATOR PUMPS & COMPRESSORS LTD., 43 BERKELEY SQUARE LONDON, W.1.
K695

Expanding sales necessitate two further TECHNICAL REPRESENTATIVES, in Yorkshire and East Midlands. Technical ability and sales experience needed. Pension Scheme. Apply in confidence, stating age and full particulars training and experience, SALES DIRECTOR, MEGATOR PUMPS & COMPRESSORS LTD., 43 BERKELEY SQUARE, LONDON, W.1.
K696

LONDON: H... LTD., by Appointment to Her Majesty The Queen, Printers, London, Hayes (Middx.), and High Wycombe, and Published by ENGINEERING Ltd., Proprietors of ENGINEERING, at 35 & 36, Bedford St., Strand, London, W.C.2.

An opportunity occurs for several FIRST CLASS CIVIL ENGINEERS to join a major Building & Civil Engineering firm for contracts in Southern England and East Anglia.

Applicants should be between 22 and 28, possess a degree or have passed parts A. & B of the I.C.E. Exam. and should preferably have had some experience with contractors, although this is not essential.

The positions offer scope for a wide variety of experience in a short space of time and opportunities may occur later for service overseas within the Company's world wide organisation.

Promotion to Agent will depend on ability but it is the Company's Policy to give early responsibility to engineers who show promise. Facilities are available for obtaining design experience for Section C.

These are worthwhile appointments intended to attract the best type of engineer who should apply in writing, giving details of past experience and present salary, to Box K.510 Offices of ENGINEERING.

A vacancy exists in factory situated in West Yorkshire country district for an experienced DESIGN ENGINEER, aged 28-35, required to be under general direction, for the development, design and manufacture of a new range of products not at present covered by the Company's manufacturing facilities. A sound theoretical knowledge of engineering principles is essential, preferably with some appreciation of chemistry and physics, and good design experience including familiarity with light metal fabrication and assembly techniques. Other requirements are adequate commercial experience to negotiate with suppliers and the ability to work closely with existing research and design staffs. The appointment, which is superannuable, offers a permanent position with considerable scope to an engineer of ability and initiative. Full particulars of qualifications and experience to Box K673 Offices of Engineering.

DESIGNERS AND DRAUGHTSMEN are required for very senior appointments in a large group of engineering companies.

Men with sound experience in the design of gears and their application in the Automobile and General Industry would be particularly welcome.

Although there is no age limit, applicants are requested to mention their age in addition to a full description of their qualifications and experience and salary requirements.

The appointments envisaged will be remunerated by exceptionally high salaries. Social benefits of a wide range and good working conditions are applicable throughout the works of the group.

Technicians with suitable experience and a willingness to reside in various parts of the country - if this became necessary - should reply to Box K690 Offices of Engineering Dept. No. 11.

BRITISH THOMSON-HOUSTON

have immediate vacancies for

TRAINED ENGINEERS

in their industrial control gear commercial department at Rugby. These appointments present good prospects for advancement. Applicants should possess H.N.C. or O.N.C. and must have completed their National Service or be exempt therefrom.

Applications, with details of experience, qualifications and salary, should be addressed to:-

MANAGER,
CONTROL SALES,
THE BRITISH THOMSON-HOUSTON CO. LTD.,
RUGBY. K.543

CARR & CO., LTD. The Biscuit Makers, have a vacancy for an ASSISTANT ENGINEER in their Factory at Carlisle.

His primary duty would be to assist in the supervision of a variety of trades in the Maintenance Department, whose responsibility includes the overhaul and repair of biscuit-making, chocolate, tin and card box, printing, steam raising and refrigeration plant. Modernisation, mechanisation and the construction of new buildings, together with the installation of plant, raise problems which will make demands on experience and ability. A man with a University Degree or its equivalent in Engineering will be chosen. His age is less important than his all round ability to get on with the job and to get on with people. The post will be permanent and the remuneration, which includes a Pension Scheme, will be based on experience and qualifications.

Applications, which will be treated in strict confidence, should be made to THE CHIEF ENGINEER, THE BISCUIT WORKS, CARLISLE. K517

THE FIRE PROTECTION ASSOCIATION has vacancies for ENGINEERS age 30 or under qualified in chemical, electrical, mechanical or structural engineering. An applicant holding a general science degree will be acceptable and a holder of H.N.C. with graduateship of the appropriate engineering institution will be considered. After about six months general experience applicant will be responsible for one section of the work which covers Industrial Processes and Raw Materials; Heating and Lighting; Buildings and Building Materials; Fire Detection and Extinguishing Systems. The Association is non profit making, formed by fire insurance companies to study fire prevention technology, to publish recommendations and to act as consultants. Salary will be commensurate with qualifications and experience. Non-contributory pensions scheme. Applications marked "Private" giving full particulars and salary required to THE SECRETARY, 15 QUEEN STREET, LONDON, E.C.4. K.674.

LABORATORY ASSISTANT required in the Research Department of the Furniture Development Council. The work is of an interesting and varied nature, mainly physical testing. Day release arrangements may be made for part time study for a University Degree. The Laboratories are situated in Holloway, London N.7. Salary depending on age and experience. Applications to: THE DIRECTOR, FURNITURE DEVELOPMENT COUNCIL, 11,ADELPHI TERRACE, LONDON W.C.2. K.773

ESSO PETROLEUM COMPANY LIMITED has vacancies in London for MECHANICAL ENGINEERS. Applicants should have an Engineering Degree and preferably be Associate Members of the Institution of Mechanical Engineers. They should have served a recognised apprenticeship and have subsequent design and construction experience on heavy mechanical engineering work, including pipework, pumps, boilers and structural steelwork. The positions offer opportunities for experience on work of considerable deversity in the development of new projects; they are pensionable, and successful candidates will be appointed to the Company's Regular Staff, Applications, giving brief details of career, should be made to the PERSONNEL MANAGER, EMPLOYEE RELATIONS DEPARTMENT, 16, CHARLES II STREET, S.W.1. K680

YOUNG UNIVERSITY GRADUATES not over 28 years, as yet uncommitted to any one career, are invited to consider application to a prominent Industrial Organisation where the work is of outstanding interest and the prospects of progress in salary and status, owing to special conditions, are unique. Desirable qualifications are a University Degree, preferably in Engineering or Science, and a keen ambition to assume responsible, well-paid work at an early age. The Company will help successful applicants to gain the requisite industrial experience. Full details will be given at interview in London, Birmingham, Manchester or Glasgow, as convenient to applicants. Please write with details of age, education and experience, to Box K684 Offices of Engineering.

WORK WANTED.

"DRAWINGS WITH TENDER?" Why not. Isometric Lay Out giving comprehensive illustration of exact proposals.—Apply BOX K 429, Offices of ENGINEERING.

B.C.S.

ONE—600 K.W. SULZER DIESEL GENERATING SET, 220/440 volts, D.C. complete with Auxiliaries, Spares, etc.
ONE—850 K.W. SULZER DIESEL ALTER-

STAINLESS STEEL available, ex-stock. Sheets, Bars, Tubes and Angles. Send for our priced Stock List.
THE MULBERRY COMPANY,
223, St. John Street, London, E.C.1.
Telephone: CLErkenwell 8356-7-8. G 456

SHEEPBRIDGE ENGINEERING LIMITED, CHESTERFIELD,
offer attractive opportunities for

PROJECT ENGINEERS

experienced in Material Handling Plant for Quarries and Collieries. Applications from DESIGNERS and DRAUGHTSMEN with qualifications in General Engineering will also be given consideration for duties of a suitable nature. Progrssive superannuated positions, attractive salaries commensurate with qualifications and experience, with provision of houses for senior positions if required. Apply giving details of qualifications experience,etc., and quoting reference EQD. to the PERSONNEL OFFICER.
K.540.

ASSISTANT CHIEF ENGINEER required by large manufacturing company in the Midlands. Applicants should have a university degree in engineering and/or Associate Membership of the Institution of Mechanical Engineers. An experienced man of personality and leadership is required who has been used to administration at a senior level. Age limit 45. Salary up to £2,500. Pension Fund. Please send details of age, education, experience and present salary to Box K520 Offices of ENGINEERING quoting Reference No. JS.39.

IMPERIAL CHEMICAL INDUSTRIES LIMITED, Plastics Division, has an immediate vacancy for a DRAUGHTSMAN for work on the instrumentation of chemical and plastics plants. Candidates should hold the Higher National Certificate in mechanical or electrical engineering. Some experience of industrial instrumentation would be useful.

A good starting salary will be paid, beyond which there is scope for progressive remuneration. Apply giving full particulars to THE STAFF MANAGER, I.C.I. LTD., PLASTICS DIVISION, BLACK FAN ROAD, WELWYN GARDEN CITY. HERTS.
K685

YOUNG MECHANICAL AND ELECTRICAL ENGINEERS, preferably with good engineering degree, required by well known firm of Consulting Engineers, to work in connection with construction and commissioning of Nuclear Power Stations.

Previous experience in the Nuclear field is not expected - arrangements will be made for appropriate training. Salary dependent on age and qualification.

Reply in writing to
Kennedy & Donkin,
64, Royal Exchange,
Manchester, 2.
K691

DESIGNER/DRAUGHTSMAN for very interesting development work on modernisation of plant in a Weldless Steel Tube Works. This is a senior position and experience of general engineering work is necessary. Permanent position and substantial salary for suitable man. Pension Scheme. Apply giving particulars of qualifications, experience and present salary to PERSONNEL MANAGER, TUBES LIMITED, ROCKY LANE, ASTON, BIRMINGHAM, 6
K837

MECHANICAL ENGINEER OR PHYSICIST required for the Research Department of the Furniture Development Council, to undertake investigations into the strengths of glued joints. Applicants should possess a University Degree or its equivalent, and should have some knowledge of statistical techniques in research. Starting salary £600/1000 p.a. depending on qualifications and experience. Applications to: THE DIRECTOR, FURNITURE DEVELOPMENT COUNCIL, 11, ADELPHI TERRACE, LONDON W.C.2.
K.775

A promient and well-established organisation with a record of expansion in industry at home and overseas has a vacancy for a QUALIFIED ENGINEER. The work is concerned with production and the effective utilisation of plant, labour and materials. Age 27 to 35, University Degree or equivalent, remuneration in accordance with experience but not less than £1,450 per annum after short initial period, and successful applicant will be expected to reach £3,000 per annum in approximately six years. Good administrative and shop-floor experience essential. Pension,Life Assurance and other benifits. Please write, with tabulated details of career, to BOX K.682 Offices of ENGINEERING.

THE HEAD WRIGHTSON MACHINE COMPANY LTD. require MECHANICAL DESIGN DRAUGHTSMEN to work on large contracts for equipment and machinery to produce steel and non-ferrous bar, tube, sheet and strip.

Experience of steelworks engineering or metal working machinery an advantage.

Higher National Certificate or equivalent normally required unless experience is exceptional.

Good prospects, 5-day week of 37½ hours, good holidays, welfar and canteen facilities.

Applications to be addressed to THE CHIEF ENGINEER, Ref.No. M.M./1, THE HEAD WRIGHTSON MACHINE CO. LTD., COMMERCIAL STREET, MIDDLESBROUGH.
K635

PHYSICISTS
AND
DEVELOPMENT ENGINEERS

LOUIS NEWMARK LTD. require a Physicist and a Development Engineer for work in their Laboratories at New Addington on the development of autopilots and associated equipment. Previous experience in this field is not essential but candidates should have some knowledge of one or more of the following - control systems, servo mechanisms, capsule instruments, optics, gyroscopes, and small instrument engineering. A degree or similar qualification is essential. Salary in accordance with age and qualifications. Pension Scheme. Apply in writing giving full particulars to PERSONNEL OFFICER, LOUIS NEWMARK LTD., PREFECT WORKS, PURLEY WAY, CROYDON, SURREY.
K678

RESEARCH OFFICER required in the Research Department of the Furniture Development Council, for fundamental investigations into problems connected with upholstered furniture. Applicants should have a University Degree or its equivalent in Physics or Mechanical Engineering. Some research experience would be an advantage but is not essential. Starting salary £600/1000 p.a. depending on qualifications and experience Applications to: THE DIRECTOR, FURNITURE DEVELOPMENT COUNCIL, 11, ADELPHI TERRACE, W.C.2. K.774

THE MOND NICKEL COMPANY LTD.

invite applications from well qualified

METALLURGISTS and ENGINEERS

having wide experience of Alloy Steels, for responsible position on its Development Staff in London. Initiative, organising ability and knowledge of modern practice in manufacture, treatment and applications of alloy steels essential. Non-contributory pension scheme.

Apply, stating age, qualifications,experience and salary required to MANAGER, DEVELOPMENT and RESEARCH DEPT., THE MOND NICKEL CO., LTD., THAMES HOUSE, MILLBANK, LONDON,S.W.I. Mark envelope 'Confidential D.28'.
K.527.

LONDON: HARR... LTD., by Appointment to Her Majesty The Queen, Printers, London, Hayes (Middx.), and High Wycombe, and Published by ENGINEERING Ltd., Proprietors of ENGINEERING, at 35 & 36, Bedford St., Strand, London, W.C.2.

DRAUGHTSMEN are wanted to fill vacancies offering good prospects in our Switchgear, Contract and Maintenance departments.

Attractive working conditions, canteen and social facilities, together with an excellent superannuation scheme, await those wishing to further their experience.

Local interviews, evenings or Saturdays, can be arranged.

Write about yourself in the first instance, quoting REF.EC to the EMPLOYMENT MANAGER, JOHNSON & PHILLIPS LTD., CHARLTON, LONDON, S.E.7.

K675

A TRAINING ASSISTANT is required by a large Iron and Steel Company to augment, in a junior capacity, the staff of the Training Officer at Newport (Mon.). His duties will be partly administrative, partly instructional and will cover the industrial training and eduction of adults and juniors. Some knowledge of and preferably practical experience in engineering and/or metallurgy are required. An additional desirable qualification is experience in teaching and/or youth work. It is regretted that the Company is not in a position to help regarding housing accommodation. Application form, to be returned within two weeks of the appearance of this advertisement will be forwarded on request to Box K676 Offices of Engineering.

An interesting and progressive opportunity occurred within a well-known Industrial Organisation for a SENIOR MECHANICAL DRAUGHTSMAN for work in the North-West London area. The successful applicant will be engaged on problems of a general engineering nature. It is necessary for applicants to have some experience in the same field. A fully apprenticed person would be preferred. Reply, stating full details of age, experience and qualifications to BOX K.784 Offices of ENGINEERING.

BRITISH OXYGEN GASES LIMITED require a SENIOR MECHANICAL DRAUGHTSMAN for work in the Cricklewood area. Applicants should preferably have had experience of plant layout and possess a good engineering background. A very good salary is offered. Canteen and Pension Fund facilities available. Reply, stating full details, to PERSONNEL DEPARTMENT, BRITISH OXYGEN GASES LIMITED, BRILGEWATER HOUSE. CLEVELAND ROW, ST JAMES'S. LONDON, S.W.1. K.781.

General Manager of important Company engaged in the sale of oxygen and gas separation plants requires a TECHNICAL ASSISTANT. Excellent opportunity for qualified Chemical Engineer or equivalent, with interest in commercial matters and some years' experience of Chemical Industry. Knowledge of German an advantage. A good salary will be offered to the right man. The appointment is permanent and pensionable. Apply, stating full details of age, experience and qualifications to BOX K.785. Offices of ENGINEERING.

ENGINEERS for development work on cables, overhead transmission systems and railway electrification schemes. The work covers a wide diversity of electrical and mechanical problems and involves the undertaking of specific projects under the general guidance of a senior development engineer. Previous experience in the electrical supply industry or traction engineering would be an advantage but is not essential. Candidates should be qualified to graduate standard or equivalent.

GRADUATE ENGINEER (MECHANICAL OR ELECTRICAL) with an aptitude for tuition required for duties which include lectures and demonstrations on the techniques and characteristics of special cables to the Company's and Customers' selected personnel. Previous experience is not essential; training can be given to the selected candidate if necessary who would have the opportunity to transfer to other duties later.

Applications to be submitted to the STAFF OFFICER, BRITISH INSULATED CALLENDER'S CABLES LTD., PRESCOT, LANCS quoting reference P/23/56.

K.795.

A CHIEF ENGINEER

is required for the North of England of a substantial group engaged in the heavy processing industry. The appointment carried a commencing salary of £I,500 - £2,000, and there are outstanding prospects for further advancement within the Organisation. Applications giving full particulars of age, qualifications and experience should be sent in confidence to BOX K.683 Offices of ENGINEERING.

PRODUCTION MANAGEMENT

A Company widely known in Industry wishes to make an early appointment to its senior staff. The Company's activities are closley interlinked with several new aspects of modern industry at home and abroad and offers valuable and broad experience to a man joining now. Qualifications required are a University Degree in Engineering or Science or equivalent, experience of Production both executive and shop-floor, personal qualities of a high order, and a strong desire to assume real responsibility at an early age and in return to advance quickly to the £3,000 - £4,000 salary bracket. Age 28 to 35. Pension and other benefits. Please apply with tabulated details of education and experience and in strictest confidence to Box K.802, Offices of Engineering.

DESIGN-DRAUGHTSMAN wanted for responsible pioneer work on nuclear instrument development in small department. Preferably H.N.C. Salary according to qualification and experience. Apply Personnel Officer, PHILIPS BALHAM WORKS LTD., 45, Nightingale Lane, London, S.W.12. Tel. BAT 8521.

K.630

GRADUATE ENGINEER (MECHANICAL OR ELECTRICAL) with sound practical background and several years experience as an Industrial Engineer (Consultant or otherwise) required by a large Company in the Electrical Industry with headquarters in South Lancs. Age preferably 30/35. An attractive and responsible post suitably remunerated. BOX K807 Offices of Engineering.

THE AUSTIN MOTOR COMPANY LIMITED,

LONGBRIDGE, BIRMINGHAM

have immediate vacancies for the following staff appointments:-

ENGINEERS FOR RESEARCH AND DEVELOPMENT DEPARTMENT

Applicants must be in possession of an Honours Degree and previous research experience would be an advantage. Vacancies exist in the Gas Turbine, Piston Engine, and General Automobile Departments.

The above posts are permanent with good prospects. Salaries are dependent on qualifications and previous experience.

The Company operates Staff Pension and Life Assurance Schemes.

Five day week.

Applications, stating age, qualifications, and previous experience to:-

PERSONNEL MANAGER

K805

Large Civil Engineering Company with Headquarters in South West Lancashire carrying out railway electrification schemes require to expand their technical and drawing office staffs immediately. Applications are accordingly invited from DRAUGHTSMEN (MECHANICAL OR STRUCTURAL) TECHNICAL ASSISTANTS (CIVIL, ELECTRICAL OR MECHANICAL) qualified to a minimum of O.N.C. standard for the design, estimating and engineering sections at Head Office, and Engineers qualified to degree standard (Civil or Electrical) for the Outside Construction Section BOX K.669 Offices of ENGINEERING

A large industrial undertaking in the North-west requires an ENGINEER FOR A SENIOR MANAGERIAL APPOINTMENT. The successful applicant will be required to control Project Engineers, Draughtsmen and Site Supervisory Staff dealing with the layout and installation of plant and services mainly in connection with large development schemes. Very sound technical qualifications are essential, the minimum being both A.M.I.E.E. and A.M.I. Mech. E., backed by wide experience following a works apprenticeship; a man who is primarily an electrical engineer is preferred. There is a contributory pension scheme and the post carries a substantial salary. Please give full details of training, experience, age and salary required, which will be treated confidentially. Box K661 Offices of Engineering.

WORK WANTED.

"DRAWINGS WITH TENDER?" Why not. Isometric Lay Out giving comprehensive illustration of exact proposals.—Apply BOX K 429, Offices of ENGINEERING.

B.C.S.

ONE 600 K.W. SULZER DIESEL GENERATING SET, 220/440 volts, D.C. complete with Auxiliaries, Spares, etc.
ONE 850 K.W. SULZER DIESEL ALTER-

STAINLESS STEEL available, ex-stock. Sheets, Bars, Tubes and Angles. Send for our priced Stock List.
THE MULBERRY COMPANY, 223, St. John Street, London, E.C.1. Telephone: CLErkenwell 8356-7-8. G 455

G. & J. WEIR, LTD.

TECHNICAL ENGINEER

required for design calculations. University degree in engineering desirable, but Higher National Certificate may be accepted; good engineering background; experience of feed pumps or turbines an advantage, but not essential. Write to TECHNICAL MANAGER, G. & J. WEIR, Ltd. CATHCART, GLASGOW, S. 4.

K660

ANDREW BARCLAY, SONS & CO. LTD.

LOCOMOTIVE AND GENERAL ENGINEERS,

have vacancies for a DRAUGHTSMAN AND ESTIMATOR, with excellent opportunities for early promotion in both vacancies. Although experience in design of steam and diesel locomotive is preferred it is not essential. Five day week, staff pension scheme, canteen facilities.

Write giving details of experience, age and salary required to, THE CHIEF DRAUGHTSMAN, ANDREW BARCLAY, SONS & CO. LTD., CALEDONIA WORKS, KILMARNOCK, SCOTLAND.

K663

GIRLING LIMITED, TYSELEY, BIRMINGHAM, require DRAUGHTSMEN in their Development Drawing Office for work on hydraulic control systems for road and rail vehicles. Previous experience in these fields would be an asset for senior men, but seniors and juniors with general experience will be welcomed. Apply by letter to PERSONNEL MANAGER, GIRLING LTD., KINGS ROAD, TYSELEY, BIRMINGHAM.11.

K.813

YOUNG ELECTRICAL ENGINEER for Development Testing Design Calculations etc. in Modern Railway Signalling Developments. Work interesting and varied knowledge electronics an advantage, but not essential. Higher National in Electrical Engineering or equivalent. Commencing Salary £600 per ann. and upwards depending on age, qualifications, experience. Permannent appointment. 5 day week.

Apply in writing to CHIEF ENGINEER, SIEMENS AND GENERAL ELECTRIC RAILWAY SIGNAL CO.LTD., EAST LANE, WEMBLEY.

K.664.

ASSISTANT RESEARCH ENGINEER, 25-35 to work on small scale Hydraulic & thermodynamic problems. Applicants must be capable of preparing their own designs for apparatus and supervising laboratory work. Some previous experience is desirable but not essential. H.N.C. is a minimum qualification. The position is in a small group of a rapidly expanding engineering Company in the South Birmingham area, and the prospects are excellent. Full details of career to date and salary required should be given and these will be treated in strict confidence. Box No. 831. 19-21, CORPORATION STREET, BIRMINGHAM, 2.

K.621

DRAUGHTSMEN, SENIOR AND JUNIOR, with general engineering experience are required for a large Plate Glass Works. The work includes plant layout, both heavy and light, design of special purpose machines, provision of building and services and the modernisation of existing machinery and plant.

The office is a medium size with about thirty persons, so that each and all get a good variety of jobs. There are opportunities for promotion for those who show an interest and aptitude for production work.

Write giving age, qualifications and experience to the CHIEF ENGINEER PILKINGTON BROTHERS LIMITED, COWLEY HILL WORKS, ST.HELENS, LANCASHIRE

K.640

MACHINE SHOP SUPERINTENDENT required for medium to heavy General Engineering Works in the East Midlands. Must have wide experience in a similar capacity, possess drive, initiative and enthusiasm. A house will, if necessary, be made available to the successful candidate.

Write in strictest confidence, giving age, experience and salary desired to Box.K.645, Offices of Engineering.

PLANNING ENGINEERS

with experience of production and assembly of light electrical equipment required by a large manufacturing company situated in the Eastern Suburbs of London. Applicants should have experience of machine shop and assembly process planning for small and large quantity production. The positions are on the established staff of the Company. Superannuation and insurance scheme in operation. The positions offer excellent opportunities and an adequate salary will be paid to the selected candidates. Please reply, giving full details of experience to Box K.616 Offices of ENGINEERING.

BUSH RADIO LIMITED require the services of a WORKS MANAGER. The man appointed will be an experienced electrical or mechanical engineer, probably with an appropriate professional qualification, in his early forties. He will have had executive experience in the running of a factory. The salary paid will depend upon age and qualifications but will not be less than £1500 per annum, with pension rights. Apply in the first instance by letter, giving a concise but complete account of training and career so far, to the PERSONNEL ADVISER, THE RANK ORGANISATION, 11, BELGRAVE ROAD, LONDON, S.W.1.

K634

STEWARTS AND LLOYDS LIMITED, Tube Works, Corby, Northants, have a vacancy for good senior mechanical engineering draughtsman, preferably with H.N.C. House available within three months. Apply to CHIEF ENGINEER, giving age, experience and salary required.

K649

TECHNICAL ASSISTANTS required age 20 to 30. O.N.C. or H.N.C. for interesting and varied work on Heat Transfer. Apply stating age, experience and salary required to DELANEY GALLAY LTD. Vulcan Works, Edgware Road, Cricklewood, N.W.2.

K.629

CIVIL ENGINEERS/CLERKS OF WORKS (two) required for WEST PAKISTAN for construction work lasting approximately eighteen months. Salary not less than £1800 per annum with free board, accommodation and medical attention but married accomodation not available. Write giving age and details of experience to Box E.G.750 c/o 191, Gresham House, E.C.2.

K631

ELECTRICAL ENGINEER, fully qualified, preferably with some telecommunications experience required for WEST PAKISTAN. Three year contract at salary not less than £150 per month with free furnished accomodation and medical attention. Write giving age and details of experience to Box EG.749. c/o 191, Gresham House, E.C.2.

K632

MECHANICAL ENGINEER OR APPLIED PHYSICIST, wishing to take a further step in his career, is offered opportunity to gain experience in leading a research team and to broaden his outlook generally. The work is concerned with metal working and fabricating processes in the iron and steel industry and is of a varied nature. There are outstanding facilities for laboratory and pilot plant investigations which are followed by full scale works trials. Location - Sheffield. Starting salary £1000 to £1250 according to age, qualifications and experience. Candidates must have leadership potential and good scientific background. Staff pension scheme. Written applications only quoting "M.W.1." to the PERSONNEL OFFICER, THE BRITISH IRON & STEEL RESEARCH ASSOCIATION, 11, PARK LANE, LONDON, W.1.

K.628

COMMERCIAL MANAGER for Old Established Medium size engineering Business, London. Must be experienced in Aeronautical and Automobile industries and have well established connections therein. Position requires thorough knowledge of tendering and price fixing and offers excellent prospects to technically qualified person with right personality. Write stating age, experience and salary required to Managing Director, Box 400, c/o 55 St. Martin's Lane, W.C.2.

K633

RESEARCH AND DEVELOPMENT ENGINEERS required for investigation into ceramic machines and processes. Previous experience in ceramic work not essential. Apply stating age, qualifications, experience and salary required to the DIRECTOR OF RESEARCH, THE BRITISH CERAMIC RESEARCH ASSOCIATION, QUEENS ROAD, PENKHULL, STOKE-ON-TRENT.

K652

LONDON: P... Ltd., by Appointment to Her Majesty The Queen, Printers, London, Hayes (Middx.), and High Wycombe, and Published by ENGINEERING Ltd., Proprietors of ENGINEERING, at 35 & 36, Bedford St., Strand, London, W.C.2.

WANTED FOR CANADA

Company of International renown has a vacancy for an ENGINEER with Power Station and General Mechanical and Electrical experience to supervise and maintain a small Power Plant Diesel Electric Locomotives, Logging Equipment, Railway Rolling Stock etc.

The ability to supervise the operation of a Plant Tool Machine Shop would be a recommendation.

The Factory is located in the province of Quebec and the salary will not be less 5000 dollars per annum. The prospects are good and the position is offered preferably to a single man but a married man would be considered.

Reply in the first instance with references to BOX K.780. Offices of ENGINEERING.

DEVELOPMENT ENGINEERS, both electrical and mechanical aged 25-35, are required by the MORGAN CRUCIBLE COMPANY LTD., Applicants, who should be of graduate or equivalent standard, should have had either experience of electronic circuiting or several years practical experience of test-bed and laboratory test procedures. The work is mainly on the design and application of new methods and equipment relating to the testing of small carbon and sintered metal components. These positions are pensionable and carry a free life insurance. We offer good working conditions, a five day week, a staff canteen, a technical library and full welfare and social amenities. Please supply in confidence, all relevant information to the STAFF MANAGER, BATTERSEA CHURCH ROAD, S.W.11. K777

FINCHIN, JOHNSON & ASSOC.LTD. have vacany for ASSISTANT in Factory Planning and Development Department. B.Sc or H.N.C. with experience in Chemical and Electrical Engineering and knowledge of Paint Industry an advantage. Salary according to age, qualifications and experience. Replies to PERSONNEL DIVISION, 4 CARLTON GARDENS, S.W.1. K.594.

ENGINEER (AGE 25-35) required for Consulting Engineers' Office in Manchester; Technical qualifications should include a degree and/or corporate membership of a major engineering institution; varied industrial experience an advantage. Technical and impartial reports following industrial accidents, commenting on safety of method of work, compliance with Statutory Regulations etc.; giving evidence in High Court if litigation ensues. Box K.592, Offices of Engineering.

Ball bearing manufacturer invites applications from MEN BETWEEN 22 AND 35 YEARS OF AGE for positions as Junior Sales Engineers throughout the British Isles. Engineering background desirable. Salary, expenses and car provided. BOX K.804 Offices of ENGINEERING.

AN OIL COMPANY in The British West Indies has a vacancy for a REFINERY MAINTENANCE Supervisor. Applicants who should not be over 40 should have gained O.N.C. after serving a full apprenticeship in mechanical engineering, and should have had at least five years subsequent experience, preferably in a Petroleum Refinery. Experience as as a Mill-wright would be an advantage. Salary will be in accordance with qualifications and experience, but not less than £850 per annum initially, with generous marriage and family allowances where appropriate. The post is permanent, and amenities include housing facilities and a pension scheme. Apply with brief particulars to Box K656 Offices of Engineering.

CHIEF DESIGNER

Chief designer required by a well established heavy General Engineering Company with an international reputation in the manufacture of mining plant, water turbines and specisl engineering projects. Applicants must possess first-class academic qualifications and proven administrative ability backed by a wide practical experience of research, design and production. An appropriate salary with superannuation will be paid. Applications with full details, which will be dealt with in strict confidence should be addressed to Box No. 131 R. ANDERSON & CO. 14, WILLIAM IV STREET, LONDON, W.C.2. K.770

ASSISTANT MECHANICAL ENGINEERS

are required by

THE STEEL COMPANY OF WALES LIMITED, VELINDRE WORKS, MORRISTON, SWANSEA.

Applicants should have served a recognised apprenticeship in mechanical engineering and should possess technical qualifications of A.M.I.Mech.E. or equivalent.

Previous executive experience in the erection and maintenance of heavy machinery is required, including steam, water, hydraulic, gas and compressed air services.

Experience of steel rolling mills and associated equipment would be advantageous.

A contributory Pension Scheme is available.

Applications, giving full details of qualifications and experience, should be forwarded to:-

THE SUPERINTENDENT OF LABOUR AND WAGES,
THE STEEL COMPANY OF WALES LIMITED,
(TINPLATE DIVISION),
CARMARTHEN ROAD,
SWANSEA K.623.

ASSISTANT WORKS ENGINEER required by industrial concern in West Midlands. Age 26 - 35. Engineering degree and industrial experience essential. Duties include supervision over maintenance and construction of wide range of plant and buildings. Salary according to qualifications and experience. Pension scheme. Housing assistance if required. Box K.716, Offices of Engineering.

TECHNICAL REPRESENTATIVE for manufacturers of lens and glass working machines. Good prospects in specialist work for applicant willing to travel both home and abroad. Write in first instance for interview, stating age, experience and technical training if any. French an advantage. To - AUTOFLOW ENGINEERING LIMITED, LAWFORD ROAD, RUGBY. K.624

DEVELOPMENT ENGINEER required by the Turbine Division, BRUSH ELECTRICAL ENGINEERING CO.LTD., LOUGHBOROUGH, to undertake investigations into mechanical, vibration and stress problems on steam and gas turbines and turbocharges. One of the duties of the successful applicant would be to initiate design, and control operation of mechanical test rigs. Applicants should preferably hold a degree or H.N.C. in Mechanical Engineering and have served an apprenticeship. Previous experience of Development work on Mechanical Engineering problems is essential.

Conditions of service include good salary, staff bonus and generous non-contributory superannuation scheme. Please apply to CHIEF PERSONNEL OFFICER K.740.

WORK WANTED.

"DRAWINGS WITH TENDER?" Why not. Isometric Lay Out giving comprehensive illustration of exact proposals.—Apply BOX K 429, Offices of ENGINEERING.

B.C.S.

ONE 400 K.W. SULZER DIESEL GENERATING SET, 220/440 volts, D.C. complete with Auxiliaries, Spares, etc.
ONE 850 K.W. SULZER DIESEL ALTER-

STAINLESS STEEL available, ex-stock. Sheets, Bars, Tubes and Angles. Send for our priced Stock List.
THE MULBERRY COMPANY,
223, St. John Street, London, E.C.1.
Telephone: CLErkenwell 8356-7-8. G 455

A SENIOR DESIGNER DRAUGHTSMAN

is required for interesting and varied work in the development department of a large industrial works near Leeds. The work entails re-organisation and layout of plant and machinery; development of new techniques and machines; and is an excellent opportunity for a man with a keen interest in operational research and development of plant and production. Special consideration will be given to applicants possessing experience in hydraulic work. Applications are invited from experienced men with a good engineering background and education to H.N.C. standard. Good salary and prospects for the right man, with opportunity to join pension scheme; assistance with housing will be considered where necessary. Applications giving full details of experience and present salary, marked "Senior Designer Draughtsman" "Confidential" to the PERSONNEL SUPERVISOR, BOX K686 Offices of Engineering.

DESIGNER DRAUGHTSMAN for interesting work on new project. Applicants should preferably be of Higher National Certificate standard with a sound engineering training, and at least five years drawing office experience. A knowledge of railway rolling stock is desirable. The position is in a small group of a rapidly expanding engineering Company in the South Birmingham area, and the prospects are excellent. Full details of career to date and salary required should be given, and these will be treated in strict confidence. Successful candidates will be required to join the Company's Superannuation scheme. "Box No. 801. 19-21, CORPORATION STREET, BIRMINGHAM 2. K.625

THE BRITISH IRON & STEEL RESEARCH ASSOCIATION
GRADUATE MECHANICAL ENGINEERS OR APPLIED PHYSICISTS to join research team in Metal Working Laboratories of the Association in Sheffield. The work comprises investigations of lubrication and plastic deformation, and provides excellent opportunities for those desiring experience of the application of techniques of measurement and of the design and development of novel equipment. Starting salary up to £900 according to age, qualifications and experience. Written applications only quoting "M.W.2." to the PERSONNEL OFFICER, B.I.S.R.A. 11, PARK LANE, LONDON, W.1. K.627

ASSISTANT RESEARCH ENGINEER, age 25-35 to work upon small scale Hydraulic and Thermodynamic problems. Applicants must be capable of preparing their own designs for apparatus and supervising laboratory work. Some previous experience is desirable but not essential. Higher National Certificate is a minimum qualification. The position is in a small group of a rapidly expanding engineering Company in the South Birmingham area, and the prospects are excellent. Full details of career to date and salary required should be given and these will be treated in strict confidence. Successful candidates will be required to join the Company's Superannuation scheme. Box No. 800. 19-21, CORPORATION STREET, BIRMINGHAM, 2. K.626.

COURTAULDS LIMITED, require the services of CHEMICAL LABORATORY AND PLANT ASSISTANTS for the Chemical Engineering Section of the Research Department. Applicants should have at least General Certificate of Education, and be of age 16 to 25 years. Laboratory Assistants will gain experience in all branches of Chemistry, with the possibility of interesting work on Pilot Plants. Plant Assistants are required for the technical control and operation of Pilot Chemical Plants, and also for experimental work of a Chemical Engineering nature.

Excellent prospects for a career in the Chemical Industry for ambitious young people, particularly ex National Servicemen. Good facilities for continuation of Technical College studies. Applications in the first instance to LABOUR OFFICER, MAIN WORKS, COVENTRY. K.593.

TECHNICAL SALES ENGINEER with recognised engineering qualification and preferably with locomotive experience required for expanding Sales Organisation of well-known Company. Age 25/35. Apply to Box.K.814, Offices of Engineering.

ASSISTANT TO CHIEF ENGINEER required for interesting plant development work in Sheffield. Applicants should possess the H.N.C. or equivalent qualifications and whilst sound experience of steelworks plant is preferred, consideration will be given to well qualified applicants with a good general engineering background including some Electrical experience.

The post is pensionable and offers good prospects to the right man. Apply in writing stating age, salary required, and giving full details of qualifications, training, and experience to ENGINEERING DIRECTOR, WILLIAM JESSOP & SONS LTD. BRIGHTSIDE WORKS, SHEFFIELD. K.665.

ASSISTANT METALLURGIST required for Commercial Motor Vehicle Manufacturers. Candidates must be experienced in metallography and production heat treatment of steels. Applications in writing giving details of qualifications, experience and salary required to A.E.C. Limited, Staff Records Office, Windmill Lane, Southall, Middlesex. K659

A large engineering company manufacturing oil engines has a vacancy for a CHIEF DRAUGHTSMAN in the Production Design Department.

Candidates must be members of the Institution of Mechanical Engineers, with previous experience in supervising Drawing Office personnel. Experience in the oil engine field is desirable but not essential, but candidates must have a sound knowledge of workshop practice and be capable of translating designs to modern production standards and requirements. Applicants should also have considerable experience in the design of mechanical engineering components and be familiar with British Standards specification requirements. Salary by arrangement. Applicants should write in confidence to Box K.620 Offices of ENGINEERING.

A large diesel engine manufacturing company wishes to appoint an ASSISTANT CHIEF ENGINEER. Candidates must have an engineering degree, or equivalent. They should have extensive experience in the field of design and development of internal combustion engines; Knowledge of torsional vibrations, and some experience of contractural engineering is desirable. Candidates within the age group 32-40 years preferred, but older candidates will receive equal consideration. Salary to be mutually agreed but will be commensurate with the responsibilities of this key position. Applications which will be handled in strict confidence to Box K.619, Offices of ENGINEERING.

An exellent opportunity occurs for a YOUNG GRADUATE SCIENTIST OR ENGINEER to gain experience of the administrative side of a large research organisation in the post of Assistant Technical Secretary of the Mechanical Working Division of THE BRITISH IRON AND STEEL RESEARCH ASSOCIATION. Work will include organisation of Committee meetings and administration of research finances, preparation and analysis of technical data, and liaison with commercial and industrial organisation. Applicants should not be more than 28 years of age. Starting salary in the range £625 - £800 per annum according to age, qualifications and experience. Post is superannuated under the F.S.S.U. Written applications only quoting "A.T.S.I." to the PERSONNEL OFFICER, B.I.S.R.A. 11, PARK LANE, LONDON, W.1. K.618

MECHANICAL DEPARTMENT FOREMAN (Working) required for Nairobi, East Africa. Sound practical man with good knowledge Diesel Engine repairs and testing and some knowledge Oxyacetylene and Electric Welding. Age 30-35. Salary £900 to £960 p.a. according to experience, plus housing allowance. Contributory Provident Fund. 3-year contract. Write with full particulars to Box "L.P." c/o J.W.VICKERS & CO. LTD., 7/8 GREAT WINCHESTER STREET, LONDON, E.C.2. K.615

SENIOR ENGINEER required by Consulting Engineer in Westminster. Would eventually take charge of Heating and Ventilating Section. Good salary, luncheon vouchers, 5 day week, pension scheme. Box.K.724, Offices of Engineering.

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SENIOR DRAUGHTSMAN required immediately for large Iron and Steel Works in the Midlands, previous experience in Iron and Steel Works not essential, but applicants should have a wide experience in general mechanical engineering. Write stating experience and salary required to Box K.719, Offices of Engineering.

J.W.ROBERTS LIMITED of Leeds and Bolton require an ASSISTANT MANAGER for their FEROBESTOS SALES DEPARTMENT, BOLTON.

Candidates should be between 28 and 38.

Should have had a sound Engineering training, and preferably possess an Engineering Degree or Technical qualification.

Outside Sales experience or experience with Technical Plastics an advantage but not essential, but applicants should have a thorough knowledge of Office Administration and routine.

This post is a progressive one. with an expanding Organisation, and will be well remunerated in accordance with qualifications and experience. Pension Scheme in operation.

Applications should be made in writing to HOME SALES DIRECTOR, J.W.ROBERTS LTD., MIDLAND WORKS, CANAL ROAD, ARMLEY, LEEDS.12. K.726.

DRAUGHTSMEN required at large expanding paper mills in Kent with experience of Civil Engineering and structural work. Must have H.N.C. in engineering or equivalent and be capable of working with minimum of supervision. Good starting salary and prospects. Assistance with housing if required. Pension scheme. Applications in writing giving age, experience and qualifications should be addressed to the PERSONNEL OFFICER, ALBERT E REED & CO.LTD, AYLESFORD PAPER MILLS, LARKFIELD, NR.MAIDSTONE, KENT, quoting reference C.E.D 2. K.728

PHILIPS ELECTRICAL LTD, invite applications for the post of CHIEF WELDING ENGINEER in the Industrial Products Division based on London but including considerable travel in the U.K. Main responsibility would involve technical liason with large scale users of Company's arc welding plant and eletrodes. Candidates should be under 40 years of age and be corporate members of a recognised professionsl engineering institution. Practical welding experience together with sound knowledge of design and production problems in heavy engineering are essential qualifications. This important post carries commencurate four figure salary with excellent pension and life assurance benifits. Applications giving details of age, qualifications and experience should be addressed to PERSONNEL OFFICER CENTURY HOUSE, SHAFTESBURY AVE, LONDON,W.C.2. quoting reference 805. K787

SENIOR DRAUGHTSMAN required immediately for large Iron and Steel Works in the Midlands, previous experience in Iron and Steel Works not essential, but applicants should have a wide experience in general mechanical engineering. Write stating experience and salary required to Box K.719, Offices of Engineering.

DESIGN AND DEVELOPMENT

The Wolverhampton branch of a world-wide industrial organisation offers permanent positions with excellent prospects of promotion for both senior and junior staff as:

TECHNICIANS

AND
DESIGN AND DETAIL DRAUGHTSMEN

These posts entail interesting design and development work in connection with atomic energy, aircraft, guided weapons and industrial engineering projects.

TECHNICIANS

Engineering or Mathematics degree preferred, although a lower qualification may be accepted from candidates with good experience. For junior positions, engineering experience is not essential.

DESIGN AND DETAIL DRAUGHTSMEN

Higher National Certificate in engineering preferred, although this may not be essential for designers with worth-while experience in mechanical engineering. For junior positions in this category, applicants studying for Ordinary/Higher National Certificates in Mechanical Engineering will be considered.

Although salaries will vary according to qualifications and experience, they will range up to approximately £1,300. for technicians, £950. for design draughtsmen and £800. for detail draughtsmen. Excellent opportunities exist for candidates possessing a particulary high potential to obtain higher salaries than those quoted.

Excellent conditions of employment include a Pension Scheme, a 5-day 40-hour week and more than adequate canteen and sports facilities.

Replies to BOX K.771. Offices of ENGINEERING.

IMPERIAL CHEMICAL INDUSTRIES LIMITED

ALKALI DIVISION

WINNINGTON, NORTHWICH,

CHESHIRE.

STRUCTURAL

AND

CIVIL ENGINEERING DESIGNERS

Vacancies exist in our Civil Engineering Department for Assistant Technical Officers to work as structural and civil engineering designers. Applicants age 25 - 40 should possess H.N.C. and have had experience either in structural work or in reinforced concrete and general building work.

Appointments are to the permanent Staff, 5 day week. with good salaries, first class working conditions and recreational facilities. Contributory Pension Fund and Profit-Sharing Schemes. Married men can receive limited assistance with removal expenses. Write for official application form to STAFF MANAGER quoting reference GES/STRUCT K.811.

DESIGNER/DRAUGHTSMAN required with sound structural engineering training and experience, and accustomed to taking responsibility. Applicants should state age, training, experience, and salary required to Box.K 720, Offices of Engineering.

CHIEF PRODUCTION ENGINEER

Applications are invited for this senior appointment by a well-known engineering Company with 2,500 employees in the Midlands manufacturing aero engines and vehicles.

Applicants (age 35-45) must have served an engineering apprenticeship and have considerable experience in production engineering.

Remuneration will be commensurate with the responsibilities involved, and there are opportunities for advancement. Pension scheme in operation.

Applications in fullest detail, giving particulars of age, education and industrial experience to Box K.732 Offices of Engineering.

DESIGNER DRAUGHTSMEN required in the Chesterfield area. Interesting work involving design and development of mechanical handling devices and a variety of heavy plant. Experience main qualification. Substantial salary, good pension scheme and five day week. Write giving details of past experience and salary required to Box.K.725,Offices of Engineering.

DESIGNER/DRAUGHTSMAN required with sound structural engineering training and experience, and accustomed to taking responsibility. Applicants should state age, training, experience, and salary required to Box K.720, Offices of Engineering.

WORK WANTED.

"DRAWINGS WITH TENDER?" Why not. Isometric Lay Out giving comprehensive illustration of exact proposals.—Apply BOX K 429, Offices of Eng

B.C.S.

ONE—400 K.W. SULZER DIESEL GENERATING SET, 220/440 volts, D.C. complete with Auxillaries, Spares, etc.
ONE—850 K.W. SULZER DIESEL ALTER-

STAINLESS STEEL available, ex-stock. Sheets, Bars, Tubes and Angles. Send for our priced Stock List.
THE MULBERRY COMPANY,
223, St. John Street, London, E.C.1.
Telephone: CLErkenwell 8356-7-8. G 456

ENGINEERING ASSISTANTS

DRAUGHTSMEN

DESIGNERS

SECTION LEADERS

Suitable candidates possessing experience and qualifications in mechanical, electrical and civil engineering are offered positions with excellent scope for advancement and remuneration by The Steel Company of Wales Limited, at their Abbey Works, Port Talbot.

The present programme of development offers vacancies for all grades of young engineers with interesting and varied work associated with layout and design of Blast Furnace plant, Coking plant and Rolling Mills.

The Company operates the largest and most modern integrated steel plant in Europe and is still expanding. The plant is laid out on the South Wales seaboard in spacious and pleasant surroundings with ideal working conditions. Good residential areas are reasonably close to the works.

An attractive pension scheme is in operation; removal expenses will be paid for a married man to a maximum of 5% of annual salary.

Interviews for these positions may be arranged at Sheffield, London or Bristol.

Those wishing to apply should write for official Application Form to:

SUPERINTENDENT, PERSONNEL SERVICES,
THE STEEL COMPANY OF WALES LIMITED,
(STEEL DIVISION)
ABBEY WORKS,
PORT TALBOT, GLAM.

K735

CONSULTING ENGINEERS
REQUIRE:

(1) Resident Engineer

(2) Clerk of Works

for construction of water supply scheme in North Borneo. Tour 12 to 18 months. Apply stating age, qualifications and experience to SIR BRUCE WHITE, WOLFE BARRY & PARTNERS, 1, LYGON PLACE, S.W.1. SLOANE 0431.

K654

DESIGNER DRAUGHTSMEN for interesting work on new project. Applicants should preferably be of H.N.C. standard with a sound engineering training, and at least five years drawing office experience. A knowledge of railway rolling stock is desirable. The position is in a small group of a rapidly expanding engineering Company in the South Birmingham area and the prospects are excellent. Full details of career to date and salary required should be given and will be treated in strict confidence. Box No. 832. 19-21 CORPORATION STREET, BIRMINGHAM,2.

K.622

BLAW KNOX LTD., a company with expanding export business, have vacancies for a FEW MEN OF INITIATIVE AND DRIVE in their Watford design office engaged on plant engineering. Communicate with PERSONNEL MANAGER, BLAW KNOX LIMITED, WATFORD, HERTS.

K.717.

METALLURGIST (QUALIFIED) with some experience in welding of alloy steels and non ferrous metals required for process control in a shipbuilding and engineering works in the north west. Must be free of National Service. Detailed applications to Box.K.741, Offices of Engineering.

A company of international standing, producing non-ferrous metals, with very large research and manufacturing facilities, wishes to employ TWO OR THREE SENIOR EXECUTIVES to establish new uses for the Company's existing products and to assist in the formulation and direction of the Company's development policy. Applicants must have exceptional theoretical knowledge and have several years experience in a senior position with at least one of the country's expanding industries such as power generation including the utilisation of nuclear energy, aeronautics, etc. It is emphasised that these are senior positions demanding imaginative thinking and offering prospects of further promotion. The salary offered is of the order of £2,000. per/annum, depending on the applicant's qualifications. Please reply to Box K.614, Offices of ENGINEERING.

SALES ENGINEER required by old established highly progressive engineering works in London. Previous sales experience unnecessary, but good general education and sound engineering training essential with H.N.C or preferably degree. Student apprenticeship with large firm an advantage. Permanent position with excellent opportunities for advancement. Contributory pension scheme. Starting salary up to £1000 depending on qualifications but we want a good young engineer with a bent for technical sales who will be worth much more to us when he has learned his work. Box K 715, Offices of Engineering.

ENGINEER to take charge of design of Electrical and Associated Accessories for the Motor Industry. Corporate membership of appropriate Chartered Institution and suitable background essential. London area. Please write full details in strict confidence to Box.K.823, Offices of Engineering.

BROOKE BOND & COMPANY LIMITED require the services of an EXPERIENCED ENGINEER FOR EAST AFRICA, AGE 30-40.

The Group operates thirteen Tea Factories with Power Plants and general services and is engaged on an extensive building and development programme.

A good salary and excellent prospects for an Engineer willing to adapt himself and acquire the specialized knowledge.

Applications to the OVERSEAS ENGINEERING & RESEARCH DEPARTMENT, GOULSTON STREET, ALDGATE, LONDON E.1, giving full details of education and experience. K.712.

MESSRS HARDMAN & HOLDEN LTD., Heavy Chemical Manufacturers, Manchester, require a CHIEF DRAUGHTSMAN.

Applicants should be between 30 and 40 years of age and have sound knowledge of drawing office administration, together with experience of chemical plant design and layout.

Minimum technical qualifications H.N.C.

The successful applicant would be expected to pass satisfactorily a medical examination for entry into the Company's contributory pension scheme.

Salary will be in accordance with qualifications and experience.

Applications should contain full details of training, technical qualifications and experience, in chronological order, together with details of present position, and be addressed to: CHIEF ENGINEER, HARDMAN & HOLDEN LTD., MANOX HOUSE, MILES PLATTING, MANCHESTER.10. K.713.

GROUP CHIEF INSPECTOR required to administrate a group of three factories in the Lancashire area engaged in the development and manufacture of a range of highly specialized engineering products both mechanical and electronic. He will need to be well versed in the requirements and conditions of M.O.S. contracts and attend conferences with Ministry and Service personnel at top level in connection with inspection matters. He will be responsible through three Chief Inspec- for the introduction of schemes for the recruitment, training and maintenance of an efficient staff of mechanical and electronic Inspectors to a strength of approximately 600, whose skill would vary from Standards Room level to female viewers. He must also have a good knowledge of materials, heat treatment and their protective processess. The successful applicant would be responsible to the Company Chief Inspector at a salary commensurate with his experience and ability Replies, in strict confidence, to Box K.718, offices of Engineering.

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IMPERIAL CHEMICAL INDUSTRIES LIMITED.
METALS DIVISION

MANAGER OF THE ENGINEERING DEPARTMENT

AND WORKS ENGINEER - KIRKBY WORKS

Applications are invited from ENGINEERS who wish to be considered for appointment as Manager of the Engineering Department and the Works Engineer of the Kirkby Works of Imperial Chemical Industries Limited, Metals Division.

The Kirkby Works manufactures non-ferrous tubes in a variety of sizes and is equipped with some of the latest automatic machinery involving a high degree of instrumentation and mechanisation. The Works is a new one and is situated on the East Lancashire Road some five miles East of Liverpool.

While plant maintenance will absorb a large part of the Works Engineer's time, it is the intention that he should devote appreciable effort to the development of manufacturing techniques and modifications to existing machinery to improve its output and performance. In this he will have the assistance of Technical staff from the Division Engineering Department and Production and Technical Departments.

The applicants should be men between 30 and 40 years of age with experience either as Works Engineer in a small Works or as an Assistant Works Engineer in a larger one. They should possess an Engineering degree and should preferably have had design experience. A system of Scheduled Maintenance is in operation and experience in the administration of such methods would be an advantage though not entirely essential. A flair for Engineering development work, mechanical handling techniques and the type of fertile brain which will produce new ideas on Production methods is required.

The appointment will be to the permanent staff of the Company and will carry the Company's Staff Benefit Schemes including Pension and Profit Sharing. The salary is appreciable and is consistent with the degree of responsibility involved. Financial assistance towards removal expenses is available for married men and, in approved cases, assistance will be given towards house purchase.

Application forms may be obtained from the STAFF MANAGER, I.C.I. METALS DIVISION, KYNOCH WORKS, WITTON, BIRMINGHAM 6, quoting ENG/21/E.

K734

PRODUCTION CONTROLLER REQUIRED for large light engineering company in West Riding. The post will involve responsibility for co-ordinating all production control functions within the works and the person appointed would be directly responsible to the General Works Manager. Knowledge of up-to-date production methods essential, with practical experience in progress, stock control, material and works ordering procedures. Applicants must have good personality, drive and enthusiasm, with strong sense of loyalty, and ability to lead the present production control team. The post is permanent, progressive and pensionable, and at an approximately high salary level. Apply, stating age, details of education and previous experience and salaries to STEVENSON, JORDAN & HARRISON, LTD., 30 WINDSOR HOUSE, 46 VICTORIA STREET, LONDON S.W.1.

K.776.

A well-known Organisation with world-wide interests wishes to recruit a YOUNG QUALIFIED MECHANICAL ENGINEER age 23/30 for appointment as an Assistant Engineer within their Production Division. The successful applicant will be come a member of a management team and should be capable of accepting a high degree of responsibility within 3-4 years. This is an attractive opportunity for the right man. The Organisation is expanding and its product is an interesting one. Reply, stating full particulars of age, qualifications and experience to BOX K.786 Offices of ENGINEERING.

PAPER MILL ENGINEER.

An Assistant is required to the Chief Engineer of a Pulp and Paper Mill in New Zealand. Age between 35 and 45 years. Must have good technical background and Papermill experience. Pulp Mill experience an advantage but not essential. Excellent prospects. A house to rent will be provided and all expenses to New Zealand will be paid including that of his family. Applicants must reply in writing stating full details of experience, qualifications to: CHIEF ENGINEER, ALBERT E. REED & CO., LTD., GROUP ENGINEERING DIVISION, LARKFIELD NR. MAIDSTONE, KENT.

K809

SENIOR JIG AND TOOL DRAUGHTSMAN required with experience in one or more of the following:-

General Engineering
Mine Cars
Tanks and Pressure Vessels (all codes)
Heavy Fabrication Work

Permanent situations with good working conditions. Five day (37½ hour) week, pension fund, housing available for suitable applicants.

Applications station age, experience, technical qualifications and salary required to:- DISTINGTON ENGINEERING CO. LTD., P.O. BOX NO.8, WORKINGTON, CUMBERLAND.

K810

A large mechanised Foundry having recently expanded the production of HIGH QUALITY STEEL CASTINGS, wishes to come to an arrangement with already established agents for the sale of steel castings on a commission basis.

The arrangement could be of considerable interest to agents who already have established connections for the sale of kindred materials and supplies, and are wishing to increase their sphere of representation. Box K.778, Offices of Engineering.

PROCESS CONTROL ENGINEERING. The Chief Engineer of a large manufacturing Company require an Instrument Engineer for conducting investigational and design work in connection with an important programme of automatic process control on a modern specialised process. Drawing Office and Experimental Engineering facilities are available, and training will be given in the science of the process. Suitable candidates should preferably be aged 26 to 35 years, and must have a degree of H.N.C. in Engineering or Physics, together with at least two years of relevant industrial experience. The successful candidate should have a practical outlook being capable of original thought and possing initiative and inmagination.

A good starting salary will be paid and there are excellent prospects in this rapidly expanding industry. Box K.760. Offices of Engineering.

RESEARCH AND DEVELOPMENT ENGINEER to supervise laboratory dealing with hydraulic and electrical products. Degree or equivalent and suitable background essential. London area. Please write full details in strict confidence to Box.K.824, Offices of Engineering.

Telephone No. STROUD 76171 — Telegrams WOODFIELD TELEX ROCHESTER — TELEX 16117 WOODFIELD STROUD

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ONE—400 K.W. SULZER DIESEL GENERATING SET, 220/440 volts, D.C. complete with Auxiliaries, Spares, etc.
ONE 850 K.W. SULZER DIESEL ALTER.

STAINLESS STEEL available, ex-stock. Sheets, Bars, Tubes and Angles. Send for our priced Stock List.
THE MULBERRY COMPANY,
223, St. John Street, London, E.C.1.
Telephone: CLErkenwell 8356-7-8. G 434

ENGINEERING ESTIMATOR or DRAUGHTSMAN required as internal sales engineer to handly quotation and specification of equipment and client negotiations. Twelve months initial service in Stroud, followed by location at Company's new offices Camberley, Surrey.

Write giving full details to SHARPLES CENTRIFUGES LIMITED, WOODCHESTER, STROUD, GLOS., for the attention of the SALES DIRECTOR. K.727.

A Company of Civil Engineering Contractors, specialising in Cement Gun and Pressure grouting work, have vacancy for YOUNG ENGINEER in their London Office.

Progressive and permanent position with pension scheme after probationary period. Duties include Site visits for supervisory and tendering purposes, preparing estimates and generally assisting on Contracts side of Company's business.

Applicants should state age, experience and give some idea of salary required to -

The Concrete Proofing Company Ltd.,
96 Victoria Street,
London S.W.1. K.731

Excellent opportunity occurs at Head Office in London for YOUNG WELL - TRAINED MECHANICAL ENGINEER possessing H.N.C. who has completed National Service. Great scope for advancement available after training and good salary offered to the right man. Apply to ABD 9, STURTEVANT ENGINEERING CO.LTD., SOUTHERN HOUSE CANNON ST., LONDON E.C.4. K.817

HYDRO-ELECTRIC PLANT ENGINEER required for overall supervision of site erection and progress of water turbines, alternators, cranes and ancillary plant in Scotland. Commencing salary according to experience and qualifications. Apply KENNEDY & DONKIN, ALLIANCE HOUSE, 12 CAXTON STREET, S.W.1, quoting ref:HH. K.730

BRUSH ELECTRICAL ENGINEERING CO.LTD., LOUGHBOROUGH have a vacancy for a DESIGN ENGINEER in the Steam Turbine Division. Applicants should hold an engineering degree or H.N.C. in Mechanical Engineering. Previous mechanical design experience is essential and knowledge of control gear would be an advantage. This is an excellent opportunity for a young designer seeking a progressive appointment in a vigorous and expanding Company. Conditions of employment include good salary, generous non-contributory superannuation and staff bonus. Please apply to CHIEF PERSONNEL OFFICER. K.739

MILLS ASSISTANTS required by The Steel Company of Wales Limited, (Steel Division), in their Rolling Mills at Abbey Works, Port Talbot.

The mills comprise of a 45" Slabbing Mill, 80" Hot Strip Mill and 80" 3-Stand Cold Reduction Mill and ancillary equipment.

The successful candidates will be required to assist the mills management in the day operating of the plant and should possess initiative and energy. The positions offer excellent scope for promotion and are permanent and pensionable. Students completing their courses will be considered.

Technical ability up to the standard of National Certificate in engineering or metallurgy. B.Sc (engineering) degree an advantage Candidates should be below the age of 35 years.

Those wishing to apply should write for official Application Form to:-

SUPERINTENDENT, PERSONNEL SERVICES,
THE STEEL COMPANY OF WALES LIMITED
(STEEL DIVISION),
ABBEY WORKS,
PORT TALBOT, GLAM. K.736

APPLICATIONS are invited for the following appointments at the CLAYDON, SUFFOLK, Works of

THE BRITISH STEEL PILING CO. LTD.

STRUCTURAL DESIGNER DRAUGHTSMAN (Minimum qualifications H.N.C. or equivalent). Candidates should be capable of accepting responsibility for complete projects.

MECHANICAL DESIGNER DRAUGHTSMAN (Minimum qualifications H.N.C. or equivalent, but consideration also given to candidates who have not yet completed their studies).

Experience should preferably (but not essentially) include equipment such as cranes, hoisting machinery (steam, diesel, electric) mechanical handling equipment, contractors' plant.

THESE ARE PROGRESSIVE PERMANENT POSITIONS IN AN EXPANDING ORGANISATION. The Company operates a contributory pension scheme and good Canteen facilities exist. Holiday arrangements will be respected. House may be available, March/April next. Salary will be in accordance with age, qualifications and experience. The Works are situated 15 minutes bus ride from the centre of Ipswich. Applications in first instance to WORKS MANAGER at the above address. K.729.

ESTIMATOR with some experience in refinery or chemical plant erection required by large Civil Engineering Contractors. Candidates must be prepared to reside on contract sites for short periods although based in London. Opportunity of joining pension fund on satisfactory service. Write, giving age, experience and salary required to Box K.733, Offices of Engineering.

DESIGNER

PERMALI LTD., require an experienced engineer. Problems include applications of Laminated Materials in Electrical, Mechanical and Chemical fields. Heavy Electrical Plant Apprenticeship and H.N.C. or Degree essential. Age 30 - 45. Details career and present position in confidence to CHIEF ENGINEER, PERMALI LTD.. BRISTOL ROAD, GLOUCESTER. K.738

Large Electrical Cable Manufacturers N.London, require PLANT LAYOUT ENGINEER. Applicants must be fit and have considerable experience of layout of plant and all services. Previous Cable Factories experience desirable but not essential. Write full details, past experience, salary required and availability to Chief Works Engineer, Box.K.743, Offices of Engineering.

PLANT LAYOUT DRAUGHTSMEN required urgently by large Cable Manufacturers N.London. Applicants must be fit and previous experience in Cable Factories an advantage. Full apprenticeship and H.N.C. desirable but not essential. Apply in writing giving full details, past experience salary required and availability to Chief Works Engineer, Box.K.742, Offices of Engineering.

JUNIOR MECHANICAL ENGINEER OR DRAUGHTSMAN with experience of chemical engineering or similar work required by large undertaking in Eire.

Age - preferably 24 to 28, good education and at least H.N.C. standard in engineering. Good practical apprenticeship and a few years D.O. experience, preferably in pipework, pumps, vessels, and general engineering.

Salary would not be less the £600. per annum, with substantial amenities.

Exceptionally good prospects for a keen man, with progressively more engineering and less draughting as responsibilities increase.

Reply to Box K.768 Offices of ENGINEERING, giving full details of training and experience.

TURBINE TENDERING ENGINEER is required for the TURBINE DIVISION, BRUSH ELECTRICAL ENGINEERING CO. LTD., LOUGHBOROUGH. This post offers considerable scope for a man of ability and initiative. Applicants must have suitable technical qualifications and should be familiar with all aspects of tendering for turbo-alternator plant. A good salary commensurate with qualifications and experience will be paid, and there is in operation a non-contributory superannuation scheme. Please reply to the CHIEF PERSONNEL OFFICER. K838

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Applications are invited for the post of ASSISTANT MAINTENANCE ENGINEER for a large engineering company in the West of England.

The successful applicant will be directly responsible to the Chief Works Engineer. He will have responsibilities in the Mechanical and Electrical maintenance of highly specialised machine tools, general plant, and maintenance of plant and equipment. He will be responsible for the control of the large labour force employed on this work. Preference will be given to a Member of the Institute of Mechanical Engineers, but the essential qualifications are a recognised Engineering Apprenticeship and a Higher National Certificate in Engineering.

Housing assistance will be given if required

Apply giving particulars of qualifications, experience and present salary to PERSONNEL MANAGER, Box K.923 Offices of Engineering.

MANCUNA ENGINEERING LIMITED, DENTON, MANCHESTER have the following vacancies in the Air Conditioning Division:

DESIGNER to take charge of the research laboratory and design and development of dust handling equipment.

SENIOR DRAUGHTSMAN with experience in Air Conditioning and Dust Extraction Plants.

SALES ENGINEER with experience in Air Conditioning and Dust Extraction Plants.

SALES ENGINEER (SENIOR) for London Area.

Applications for the above positions with this rapidly expanding Company should be addressed to the GENERAL MANAGER with full details of experience, present salary etc. K.937

VICKERS-ARMSTRONGS (ENGINEERS) LTD., ELSWICK AND SCOTSWOOD WORKS, NEWCASTLE UPON TYNE.

Have vacancies for men in various sections of these Works:

RESEARCH ASSISTANTS
H.N.C. OR B.Sc.

DRAUGHTSMEN
O.N.C. MINIMUM

TECHNICAL ARTISTS.

For interview or more details write:
PERSONNEL OFFICER,
at the above address.
K836

IMPERIAL CHEMICAL INDUSTRIES LIMITED

METALS DIVISION

Applications are invited for the post of

DEPUTY MANAGER

at the Summerfield Research Station, Kidderminster, Worcestershire. The work of this establishment is the design and development of large solid propellant rockets for Guided Missiles and involves a wide range of scientific activities.

The post is a senior one, involving considerable responsibility and commensurate salary. Applicants should have high engineering qualifications, design experience, interest in research and development work, and possess administrative ability and aptitude for leadership.

For a suitable man, the post affords interesting work in excellent conditions with a first-class team. The appointment will be to the permanent staff of the Company and will come under the Company's usual staff conditions including pension and profit-sharing arrangements. After joining the staff, married men will receive a reasonable refund of removal (including travel) expenses, and to assist them in house purchase, facilities are available, in approved cases, for substantial loans; in addition, legal charges will be advanced.

Applications should be addressed to the PERSONNEL DIRECTOR, I.C.I METALS DIVISION, WITTON, BIRMINGHAM 6, quoting SM/1/E. K.931.

FUEL EFFICIENCY ENGINEER - Reed Paper Group requires a Fuel Efficiency Engineer to operate a mobile testing unit. The successful candidate will be based at Aylesford, Kent but will spend part of his time carrying out surveys of plant at other factories within the Group. Higher National Certificate or equivalent. Applicants must have had experience in the operation of water tube boilers and/or shell boilers, in steam utilization and the testing of plant. Age 25 to 35 Apply in writing to the PERSONNEL OFFICER, ALBERT E.REED & CO.LTD., AYLESFORD PAPER MILLS, LARKFIELD, NR.MAIDSTONE, KENT. quoting reference F.E.2. K.793.

DESIGNER SALES/ENGINEER for steel fabricating works in Nigeria to deal with customers enquiries for road trailers, drop-sided and tipping truck bodies, road and storage tanks etc. Commencing salary £1,150 per annum plus allowances which include free passages for self and wife, free dwelling quarters, 3 months home leave on full pay after 18 months service in Nigeria. Apply in writing to - FRANK IMPEY & CO., 144 GREAT CHARLES STREET, BIRMINGHAM.3. K.925

SENIOR EXECUTIVE ENGINEER required to establish and run a new E.O.T. Crane Works and Design Office as extension of existing well known crane business. Would be expected to take full responsibility for design and manufacture of E.O.T. Cranes up to 50 tons capacity. Salary commensurate with experience but not less than £2,000 p.a. Write stating age, experience and qualifications to Box. K.929, Offices of Engineering.

CHIEF JIG AND TOOL DRAUGHTSMAN required by West Lancashire firm of medium/heavy precision engineers. Applicants must have experience in a similar capacity, have served a recognised engineering apprenticeship and hold Higher National certificate. Permanent situation with superannuation scheme. Salary will be paid in accordance with experience and ability. Please submit details of age, experience and qualifications to Box.K.924, Offices of Engineering.

STEAM AND POWER ENGINEER required for a Pulp and Paper Mill in New Zealand. Must have good technical knowledge of steam generation and ulitization and experience of power plant layout, design and operation. A house to rent will be provided and all expenses to New Zealand will be paid including that of his family. Applications in writing stating full details of experience, qualifications to:- CHIEF ENGINEER, ALBERT E.REED & CO.LTD., GROUP ENGINEERING DIVISION, LARKFIELD, NR.MAIDSTONE, KENT. K.794

SITUATION WANTED.

GRADUATE CANADIAN CIVIL ENGINEER, 21 desires work in Britain 1 or 2 years, to gain experience in hydraulics. Available Oct. 1956, sooner if assisted with travel expenses. Box K. 491 Offices of ENGINEERING.

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ONE—850 K.W. SULZER DIESEL ALTER...

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THE MULBERRY COMPANY,
223, St. John Street, London, E.C.1.
Telephone: CLErkenwell 4...

BUSINESS WANTED.

MARINE EQUIPMENT MANUFACTURERS desire to acquire an interest in small or medium Engineering Works to act as sub-contractors. Area preferably N. or N.W.London, Middx or Herts. Tax losses an advantage. Apply Box K.791, Offices of Engineering.

MACHINERY FOR SALE.

2 - RYDER 5-SLIDE FORGING HAMMERS for sale. Capacity round and square bars up to 1¾ in, tubes up to 3in. diameter. Weight about 36 cwts. each. Similar 4-slide Machine also available. Photos, F.J. EDWARDS LTD., 41, WATER ST. BIRMINGHAM 3. CENTRAL 7606. K657

BALLARD DRYING OVEN for sale, gas heated, with belt conveyor. Approximate size of oven 40ft. long x 12ft. wide x 4ft. high. Excellent condition. View in S. Wales. Full details F.J. EDWARDS LTD., 359, EUSTON ROAD, LONDON N.W.1. EUSTON 4681 and from 41, Water St. Birmingham 3. CENTRAL 7606. K658

WANTED.

WANTED, HORIZONTAL HOT OR COLD START OIL ENGINES, also old Hornsby paraffin engines started by blowlamp. HOPKINS, ENGINEER, FRAMPTON COTTERELL, BRISTOL. K.711.

PLANT REQUIRED

TWO SECOND HAND BOILERS, Economic type, 5-6000 lbs. per hour evaporation, in good condition. Mechanical stokers and other accessories also required. Please send details to Box K672 Offices of Engineering.

FOR SALE.

MACHINING AND FOUNDRY CAPACITY. Well-known north of England engineering company can offer prompt delivery of iron castings up to 6-tons and medium turning, copy turning, grinding, vertical boring, planing, gear cutting. Particular attention to long-term contract work. Box K.723, Offices of Engineering.

GARDNER 6 L.W. OR 8 L. 3. ENGINE AND GENERATOR SET complete. Also PAXMAN 300 H.P. 500 R.P.M. DIESEL ENGINE WITH ALTERNATOR AND SWITCH GEAR, giving off 287 K.V.A. at 440 volts. Full details and sensible prices only to Box K655 Offices of Engineering.

SALT BATH EQUIPMENT - comprising
One set 6M.S. Chills.
Hot Rinse Tank with thermostatic control. One Salt Bath Pot 8' x 3' x 3'. One IVO complete Salt Bath Installation. (Gas fired Salt Bath furnace etc.).

This may be viewed by appointment at FRIGIDAIRE DIVISION OF GENERAL MOTORS LIMITED, STAG LANE, KINGSBURY, LONDON, N.W.9. Reference SEF. Colindale 6541. K681

ONE PAXMAN 300 B.H.P.TYPE 12 RPH 'RICARDO' vertical twelve cylinder diesel oil engine. Complete with electric starting equipment and batteries etc. Coupled with Lancashire Dynamo 310 KVA motor alternator set. Complete with switch board etc.

Further information apply THE CRITTALL MANUFACTURING CO.LTD., BRAINTREE, ESSEX. K.821.

FOR SALE

HORIZONTAL THREE THROW HYDRAULIC PUMP by Davy Bros. Rams 2½" dia. x 6" stroke capacity 18 galls. per minute with 30 HP Squirrel Cage Motor & Starter (oil immersed) 1520 lbs. per sq. in. W.P.
Inspection here.
MADEN & MCKEE LTD.
317 PRESCOT ROAD.
LIVERPOOL. 13 K834

"FOR SALE"

1 - 3 THROW HYDRAULIC PRESS with Accumulator. Press made by John Shaw, W.P.1,250 lbs per sq.in., including 60 H.P. Motor 440/3/50. Accumulator 10½" diameter Ram, Steel Ballast case 8' diameter x 12'6" deep, capacity 60 Tons for W.P. 1500lbs per sq.in., Reply Reference DILM. Box.K.714, Offices of Engineering.

FOR DISPOSAL

The following second-hand plant:-

1 - OLDFIELD & SCHOFIELD PISTON RING HAMMERING MACHINE, Serial No. 5562/A.16866. Capacity 8" - 26" diameter. Condition - as new.

1 - SPECIAL PURPOSE MACHINE suitable for ring grooving or second operation. Hydraulically equipped. Capacity 5" over bed

Can be seen by appointment at CLEWS PETERSEN LTD., MILL LANE, LONDON, N.W.6. (Mr. S.C. LOBB). K687

PATENTS.

THE OWNERS OF BRITISH PATENT NO.693790 " IMPROVEMENTS IN AND RELATING TO FRAME WORK FOR TYPEWRITERS", desire to secure commercial exploitation of the invention in the United Kingdom, under licence or otherwise. Enquiries to W. H. BECK,GREENER & CO., 7 STONE BUILDINGS,LINCOLN'S INN, W.C.2. K.799.

THE OWNERS OF BRITISH PATENT NO.689940 "IMPROVEMENTS IN AND RELATING TO TYPEWRITER CASES", now desire to secure commercial exploitation of the invention in the United Kingdom, under licence or otherwise. Enquiries to W. H. BECK, GREENER & CO., 7 STONE BUILDINGS, LINCOLN'S INN FIELDS, W.C.2. K.800.

The Proprietors of Letters Patent No.686435 relating to "Apparatus for preparing mixtures of clay and water" desire to grant licences under the patent to interested parties on reasonable terms for the purpose of exploiting the same and ensuring its full commercial development in this country.

Enquiries to be addressed to: Cruikshank & Fairweather, 29 Southampton Buildings, Chancery Lane, London W.C.2. K.796

THE PROPRIETORS OF PATENT NO.613055 for "Improvements in or relating to Methods of Infolding and Machines therefor" desire to secure commercial exploitation by Licence or otherwise in the United Kingdom. Replies to Haseltine Lake & Co., 28, Southampton Buildings, Chancery Lane, London W.C.2. K 830

THE PROPRIETORS OF BRITISH PATENT NO.686411 which relates to linear dimension gauges, are desirous of exploiting the invention by way of licence or sale. Enquiries should be addressed to ANDREWS & BYRNE, 201 BANK CHAMBERS, 329 HIGH HOLBORN, LONDON W.C.1. K.703

THE PROPRIETOR OF BRITISH PATENT NO. 652686 for "PINKING SHEARS AND METHOD OF MANUFACTURING SAME", desires to enter into negotiations with a firm or firms for the sale of the patent, or for the grant of licences thereunder. Further particulars may be obtained from MARKS & CLERK, 57 & 58, Lincoln's Inn Fields, London W.C.2. K744

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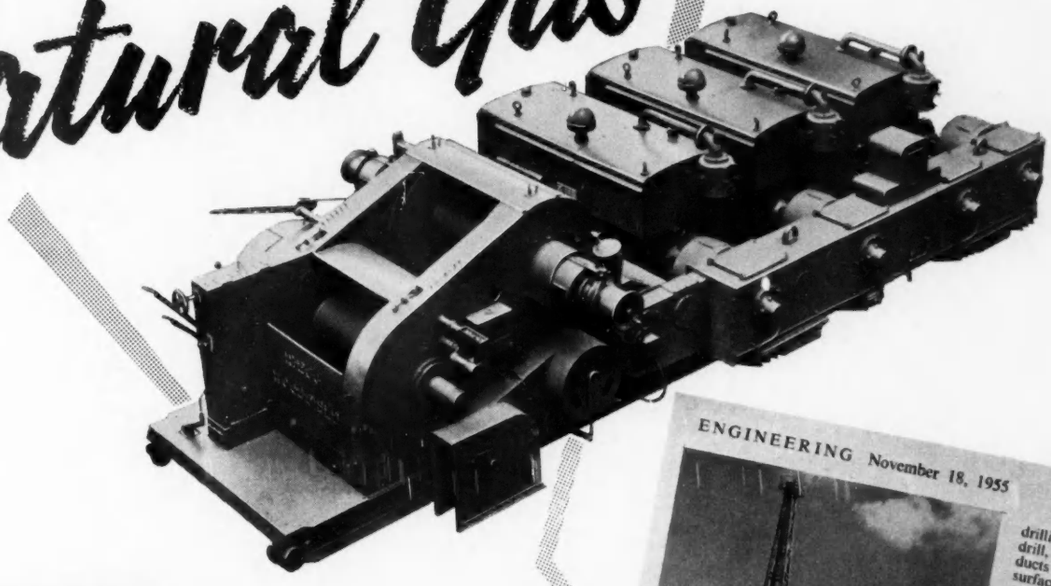
Drilling for Natural Gas



WOODFIELD OF ROCHESTER built the IDECO / WOODFIELD H.40-D Hydrair Double Drum Drawworks with 3 A.E.C. Engines, 450 H.P. 4 shaft drive compound for this rig operated by D'Arcy Exploration Company in drilling operations carried out for the Gas Council at Crowborough, Sussex.

ENGINEERING November 18, 1955

Fig. 5. Exploratory drilling for natural gas at Crowborough, Sussex. The jack-knife derrick is 87 ft. high; in the background are mobile geological and petroleum engineering laboratories.

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WOODFIELD makers under licence of **IDECO** Oilfield Equipment

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More earth moved faster by Challenger

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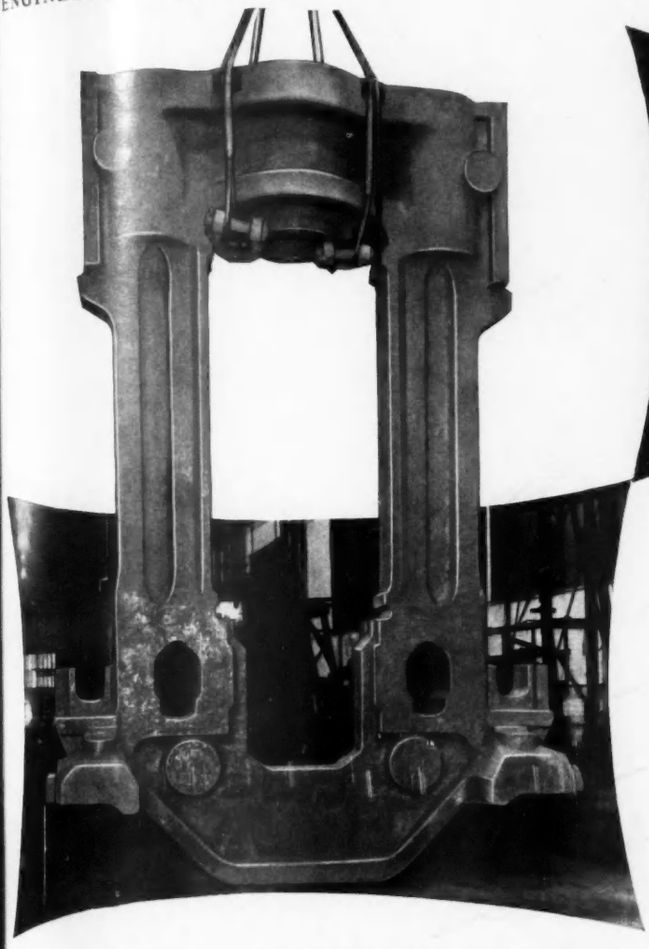
Concessionaires for Great Britain: Thomas W. Ward, Albion Works, Sheffield 4



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up to 50 tons, finished Weight

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Plates, Sections and Bars

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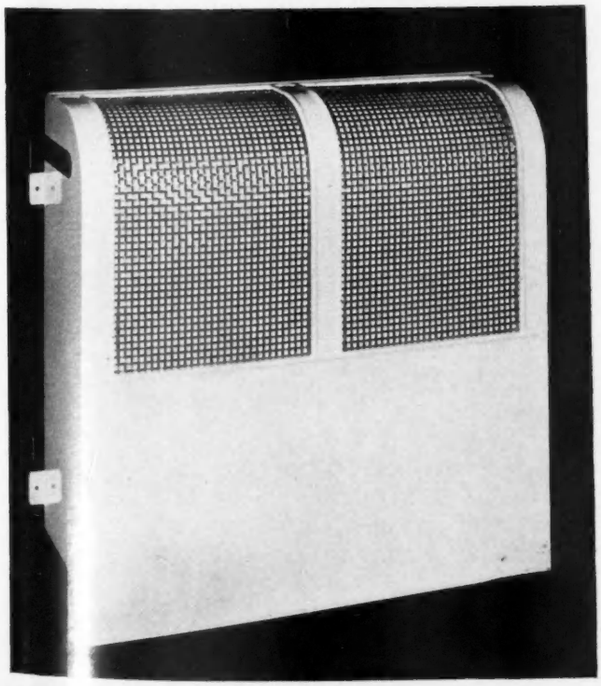

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the world's air-speed record
was broken by a Gloster Meteor, powered
by Rolls-Royce jet engines:

SPEED 616 m.p.h.

The main jet engine
bearings were made by

F.B.C.

IN 1956

the world's air-speed record
was broken by the Fairey Delta 2,
powered by a Rolls-Royce jet engine:

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